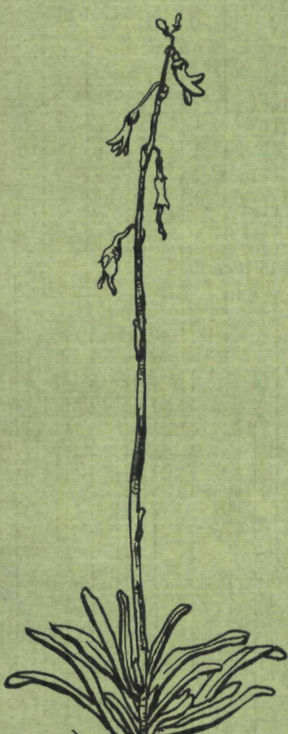
LITTORELLETEA

A study of the vegetation of some amphiphytic communities of western Europe



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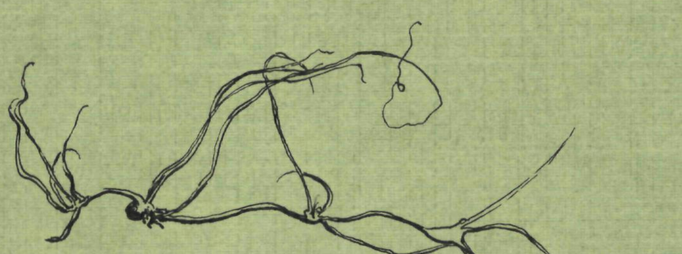

LITTORELLETEA

A STUDY OF THE VEGETATION OF SOME AMPHIPHYTIC COMMUNITIES OF WESTERN EUROPE

Promotor: Prof. Dr. V. Westhoff

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A STUDY OF THE VEGETATION OF SOME AMPHIPHYTIC COMMUNITIES OF WESTERN EUROPE

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR IN DE WISKUNDE EN NATUURWETENSCHAPPEN AAN DE KATHOLIEKE UNIVERSITEIT TE NIJMEGEN, ÒP GEZAG VAN DE RECTOR MAGNIFICUS PROF. MR. F.J.F.M. DUYNSTEE VOLGENS BESLUIT VAN HET COLLEGE VAN DECANEN IN HET OPENBAAR TE VERDEDIGEN OP DONDERDAG 21 JUNI 1973 DES NAMIDDAGS TE 2 UUR PRECIES.

DOOR

MARGARITA MARIA SCHOOF-VAN PELT

GEBOREN TE TILBURG

1973

DRUK: STICHTING STUDENTENPERS NIJMEGEN

aan Dick,
die meer deed dan gedogen

Ach, die Welt ist so geräumig,
Und der Kopf ist so beschränkt

Wilhelm Busch (1832-1908)

CONTENTS

Chapter I

INTRODUCTION

I.1 History of the investigations

In 1947 the Department of Nature Conservation and Landscape Management was founded within the Dutch State Forestry Service. Its main scope was to take inventories and to carry out ecological investigations relating to choice and management of nature reserves. Within this scope, the need was felt to have at the Department's disposal a survey of the biotic communities worth while being considered for protection and conservation.

The intention was:

1. to outline the major synecosystems (groups of ecosystems), such as shifting sands, dry pastures, moorland, deciduous woodland, salt marshes, swamps and former river beds;
2. to describe, within the most threatened of these synecosystems, the various plant communities characteristic of them;
3. to make an inventory of all separate sites representative of such ecosystems;
4. to arrange these representatives in a sequence according to criteria such as: optimal development, degree of disturbance, size of the stand, number of rare and characteristic taxa;
5. to determine which stands needed to be protected most urgently.

Because of the limited provisions (staff and funds) of the Department, financial support was asked from the Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek Z.W.O. (Netherlands Organization for the Advancement of Pure Research). This Organization, however, does not intend to support any investigation carried out by an „applied" institute. The Netherlands Organization for the Advancement of Applied Research (T.N.O.) on the other hand would have considered the intended research not to be „applied", because it did not aim to increase the productive capacity of the human society. As a result the intended research came down between two stools. As a way out, the Department of Nature Conservation and Landscape

Management founded a subsidiary body, the „Stichting Onderzoek Levensgemeenschappen" or S.O.L. (Foundation for the Investigation of Biocoenoses), which assumed the specific task of making a survey of biotic communities being considered for protection and conservation. This organization was financially supported by the Netherlands Organization for the Advancement of Pure Research. In 1956, the research task of the Department of Nature Conservation and Landscape Management of the State Forestry Service was assumed by the State Institute of Nature Conservation Research, founded in that year.

In the years 1954-1956, the S.O.L. carried out an investigation and evaluation (as rendered above) of the synecosystem of the former river beds. The results of the study were published in a separate volume of Wentia (5, 1961, 258 pages).

A similar investigation was considered necessary for another type of threatened ecosystem, the moorland pools. This study was undertaken by the S.O.L. and carried out by the following investigators: C.A. Bastiaanssen, Drs. J. van Donselaar, Drs. P. Glas, H. Moller Pillot, J.H. Peters, H.J. Verhoeven and E.E. van der Voo.

The study was published, with the understanding that mimeographed reports of all investigated stands have been issued. The importance of the investigation for Nature Conservation has been shown to full advantage. One could indicate, with the aid of the reports, the priority of which moorland pools had to be protected and adequately managed. The reports had a limited distribution, however; a summarizing publication, in which the syntaxonomy, synecology and synchorology of the observed vegetation units was described, was never published. In this respect the investigation is, therefore, not finished.

It was the intention of the present author to use the data of the S.O.L. investigations as a starting-point for her own investigations of the vegetation of moorland pools. However, since she has not taken part in the former research, it was not considered appropriate to simply assemble the formerly collected data into a publication. On the other hand, it would be regrettable if use was not made of these data.

Due to a limited amount of time avaible for the study, a choice had to be made concerning the number of Dutch localities presently investigated; the choice of localities and vegetation types was based on the data of the S.O.L. investigations.

I. 2 Scope of the investigations

The present study can be best described as a comparative phytosociological investigation of the vegetation types of oligotrophic and mesotrophic moorland pools and similar waters in The Netherlands and adjacent territories.

The investigated ecosystem type, the moorland pools („vennen" in Dutch) are completely or for the greater part, isolated, stagnant, fresh water pools occurring on an originally oligotrophic substrate (usually holocene blowing sand or pleistocene coversand, as well as fluvioglacial sand). These pools show vertical water movement, and therefore, have fluctuating water levels. They can run dry completely or partly during a shorter or longer period of the year.

The water is of oligotrophic or dystrophic origin, but it may have a metatrophic character because of zoogenic influences (guanotrophy) or because of anthropogenic disturbances. The term metatrophic is taken from LEENTVAAR (1958), and is discussed in SEGAL (1965) and SCHROEVERS (1966).

The pools are usually of aeolic origin, but in some cases they have originated by water movement (former river or brook bed, which became isolated) or by glacial influence (FABER 1948).

Flora and vegetation of these moorland pools have an atlantic to subatlantic character (WESTHOFF et al. 1946, DIERSSEN 1972, Chapter VI of this study). This type of ecosystem is geographically restricted to Ireland, Great-Britain, Denmark, north western Germany, The Netherlands, Belgium and France (north of the mediterranean region). In a wider sense, the moorland pool ecosystem also occurs in shallow, oligotrophic and minerotrophic waters of East Germany, Poland and Scandinavia.

The present author was mainly concerned with the type of pools which are most threatened by human disturbance. Phytosociologically the most characteristic vegetation of these moorland pools can be assigned to the class Littorelletea. Such pools are usually situated in stable gradient habitats, such as in transition zones between moorlands or forests on holocene blowing sand, pleistocene coversand or fluvioglacial sand (poor in nutrients), and areas which are richer in nutrients, such as the valley of a brooklet or a river.

In some cases anthropogenic influences can be positive for the origin and maintainance of Littorelletea communities, provided that they are small, and stay quantitatively and qualitatively the same.

It was also the scope of the investigation to examine if changes in the vegetation and the habitat have taken place in the decade since the S.O.L. investigations. If such changes were encountered, these had to be registered and interpreted. One would expect that in many cases the influence of „cultural actions" by man has caused a change in the chemical composition of the water (metatrophy), which may have caused a change in the vegetation. A causal interpretation of these changes may lead to a deepening of our understanding of the tolerance (ecological amplitude) of a number of taxa towards the habitat.

The study of changes in the vegetation and in the habitat of moorland pools could be extented to a period before the S.O.L. investigations. The late Dr. Ir. W.H. Diemont placed his moorland pool relevés at my disposal, which were made in the provinces of Friesland, Drenthe and Overijssel in the years 1936-1940. Dr. Ir. G. Sissingh offered the relevés that he made in moorland pools in the provinces of North-Brabant and Limburg in the years 1941-1943. These, hitherto unpublished, relevés allow a comparison of the almost undisturbed vegetation and habitats in the forties with the more disturbed vegetation and habitats in recent times.

I.3 Scientific importance of the study

The vegetation and the vegetation units of the atlantic oligotrophic moorland pools and similar waters in western Europe have not been investigated previously in a satisfactory way. There are either incidental publications concerning a small, restricted area, or broad surveys with insufficient documentation. A monographic revision has failed to come, either from The Netherlands or from the surrounding countries.

The study of these communities is important because of the rare and specific character of the ecosystems in various aspects: in the plant geographical respect because of their strong bond to the atlantic province; in the synecological and the autecological respects because they are well adapted to fluctuating water levels (the adaptation of the species to this habitat factor have led IVERSEN (1936) to distinguish the amphiphyte life form for most of them). On the other hand, it appears from the present study that these communities are stenoecous as for the factors light, nature of the substrate and mineral composition of the water. They are very sensitive to any form of water pollution.

A monographic study of these plant communities is urgently needed, because in the whole of western Europe, and especially in The Netherlands, they are disappearing quickly as a consequence of the rapid increase in eutrophication and levelling down of the biosphere (re-allotment, reclamation, drainage, industrialization, canalization, increase of the number of highways, misuse of herbicides, mass recreation etc.).

The plant communities of the most oligotrophic pools are only dependent on rain for their water and food supply; they can be adequately protected against disturbances, expecially eutrophication, by eliminating human influence. This can be realized in a number of cases by effective preservation in nature reserves.

The situation is far more complicated for mesotrophilic plant communities. Pools which were originally oligotrophic have been moderately enriched with nutrients during ages, and a stable, mesotrophic situation resulted. The enrichment took place for example by a brook or a river traversing the marginal areas of the former agrarian society. Examples include the Winkelsven in the municipality of Boxtel which is fed by the brook Beerze (WESTHOFF & VAN DIJK 1953), the Taamven in Valkenswaard, fed by the river Dommel and the Beuven in Someren, fed by the brook Peelrijt. These streams are polluted now because of intensive agriculture (use of artificial fertilizers) and other factors, so that their influence on the vegetation of the pools, which used to be positive, has turned in the negative direction.

It is extremely difficult to preserve such biotopes in nature reserves, since the agricultural pattern conditioning them currently rarely exists and such biotopes are rapidly disappearing, at least in The Netherlands. It was urgent therefore, to study the relics of the oligotrophic moorland pools before it would be too late. The deterioration of the biotope could be studied by means of the relevés made by W.H. Diemont, G. Sissingh, the S.O.L.investigators and the present author throughout the last 35 years.

I.4 Investigated areas

The study focused on the vegetation of moorland pools in The Netherlands. Such pools are found primarily in the pleistocene regions, on sands in the northern, eastern and southern part of the country (PANNEKOEK 1956, Fig. 1). Phytogeographically, these areas belong to the Drenthian, Subcentral European, Guelders and Kempen district (VAN SOEST 1929). All these phytogeographical districts are represented in the present study.

The vegetation most characteristic of moorland pools, assigned to the

Littorelletea (I.2), is best developed in the Kempen district, which was, accordingly, visited most frequently. In the Drenthian district the vegetation of moorland pools is usually very poor in Littorelletea species (WESTHOFF & BARKMAN 1967).

Communities which are similar to those of moorland pools are found in valley pools in the (holocene) dunes of the West-frisian Islands; they belong to the Wadden district. These communities are best developed in the dune area of the island of Terschelling. The dune sand of this island is the poorest in lime and the most acid of all West-frisian islands. Therefore, the flora of the dune area of Terschelling bears a certain resemblance to the flora of the pleistocene areas of the continent (WESTHOFF 1947). This island is also involved in the investigation.

The vegetation of moorland pools in The Netherlands cannot be properly understood, if it is not compared with similar vegetation in other regions. Therefore, regions outside The Netherlands had to be studied. The choice of these regions has been mainly determined by two criteria.

Firstly, the atlantic to subatlantic character of the vegetation of the moorland pools must be taken into account. This brings on that the atlantic

Hondeven at Tubbergen, Overijssel. Photo by E.E. van der Voo.

to subatlantic areas of Europe were considered for visits, viz. Denmark, north western Germany, (The Netherlands), Belgium, France, northern Spain, the north part of Portugal, Great-Britain, Ireland and western Norway.

Within this area the choice is further restricted to regions where the given ecosystem type is well developed. This is the case in those regions where the specific semi-natural landscapes are sufficiently present, and where the ecosystem is not or only slightly affected by the influences of excessive urbanization and industrialization, in other words, where there is little or no pollution. This implies that primarily the sparsely populated regions within

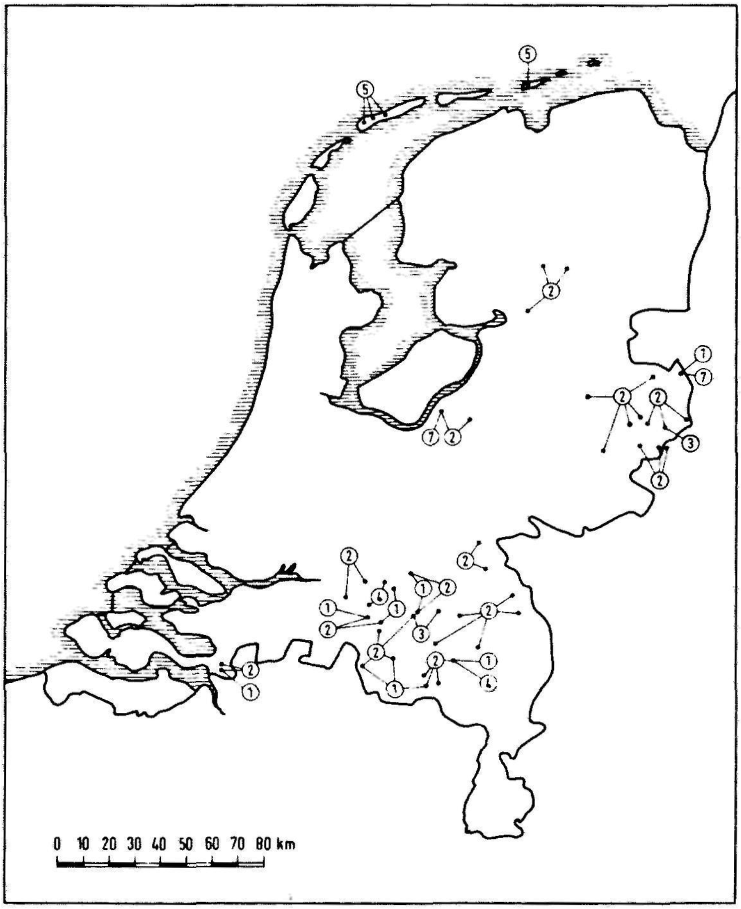

Fig. 1. The areas investigated in The Netherlands. Numbers refer to associations indicated in Fig. 2.

the atlantic-subatlantic area must be considered.

Countries such as Denmark, western Germany and Belgium are not among the first to be visited, as most moorland pool ecosystems have disappeared from these areas. One may be astonished that a number of such pools is relatively well preserved in The Netherlands, the most densely populated country in Europe. Thanks to a very active and long-established nature conservancy organization (dating from 1905) some of the most interesting moorland pool ecosystems have been protected in nature reserves, and are therefore still preserved.

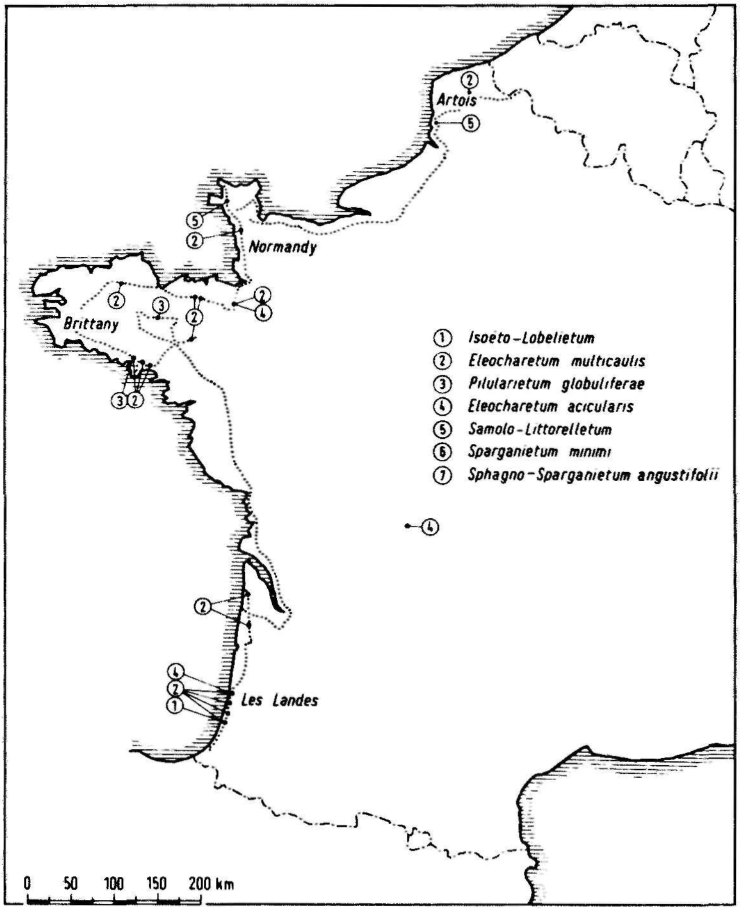

Fig. 2. The areas investigated in France.

The conditions of most of the Dutch moorland pools, however, were worse than was expected; in many of them only fragments of the characteristic vegetation were present. This gave extra value to the studies of pools outside The Netherlands. It served not only for comparison purposes, but also provided data which could no longer be collected in The Netherlands.

Excursions were made to France, Ireland, and Great-Britain. In France the aquatic vegetation of pools and lakes was studied in Les Landes (south western part of the country), in Brittany and in Artois. In Ireland most attention was paid to the aquatic vegetation of Connemara, Co. Galway, but areas further south and north along the west coast were also visited (from Co. Donegal to Co. Clare). In Great-Britain the study was centered in Scotland, especially the northern part; less time was spent in the Lake District in

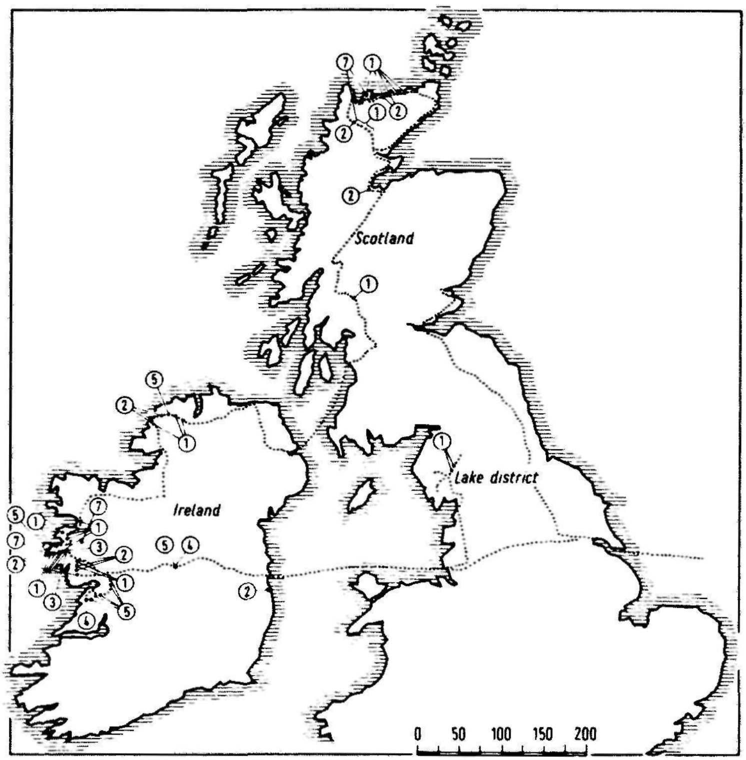

Fig. 3. The areas investigated in Great-Britain. Numbers refer to associations indicated in Fig. 2.

England. In a number of the latter lakes the characteristic vegetation had disappeared because of intensive recreation; in others the vegetation was inaccessible because of steep slopes. All visited locations can be seen on the maps of Figs 1-3.

Spain was not visited; in this country Littorelletea communities are rare and restricted to the Euro-Sibirian and Alpine regions (TÜXEN & OBERDORFER 1958).

Although the larger part of Scandinavia cannot be assigned to the atlantic or subatlantic region, it contains many aquatic plant communities that are related to the vegetation of moorland pools. Since the scope of the study requires a certain restriction in the areas to be investigated, it was decided not to involve Fennoscandia (apart from Denmark).

Chapter II

METHODS

II.1 Vegetation analysis

The starting-point for the investigation is the empirical fact that the populations of plant species are not dispersed at random in the vegetation of the earth The species appear to occur in a large number of distinct combinations, which may be presumed to be related to specific habitats

In the present study the methods of the French-Swiss School or Zurich-Montpellier School have been applied They are explained in detail in BRAUN–BLANQUET (1928, 1951, 1964), in its English translation by CONARD & FULLER (1932), in ELLENBERG (1956) and in SHIMWELL (1971)

The value 2 of the scale of the cover-abundance or combined estimation is replaced by the values 2m, 2a and 2b, after BARKMAN, DOING & SEGAL (1964), to allow a distinction between abundance (2m) and cover degree (2a and 2b)

The designation *typicum* for subassociations (or lower syntaxa) that are not marked by differential taxa is only used if the subassociation is provided with the full normal characteristic species combination of the association In most cases, however, at least in the present study, a subassociation without differential taxa is impoverished in comparison with other subassociations. In that case the denomination *inops* (impoverished) is used, after WESTHOFF (1965)

The term *syntaxon*, analogous to the term taxon used in plant systematics, is applied to abstract vegetation units of any rank, that are distinguished with the methods of the French-Swiss School, viz subvariant to class (WESTHOFF & DEN HELD 1969) For abstract vegetation units, irrespective of which criterion is used to distinguish them, the therm *coenon* is applied, as it is used in WESTHOFF & DEN HELD (1969)

In the tables (at the back of the book) the taxa are arranged according to the following principle: first the character taxon (taxa) or differential taxa of the association are given, followed by taxa that characterize any other Littorelletea syntaxon. Then the „companions" follow. They are not rendered in one group, as is done frequently, but they are arranged according to the syntaxon they represent. This procedure is adopted from SEGAL & WESTHOFF (1959). In this way far more ecological information is given for a relevé, than when all „companions" are grouped together, without any other specification than „companions".

Bryophytes and algae form the last group. The syntaxonomical position of bryophytes and lower taxa is neglected by many phytosociologists and therefore the syntaxonomical value of these taxa is insufficiently known. It is for this reason that these taxa are unified into a taxonomical instead of a syntaxonomical group.

In several cases taxa occuring in only one or two relevés are mentioned separately at the foot of the table.

Some taxa seem to demand a very dynamic habitat; they are found in habitats with sharp boundaries, with a coarse grained pattern (few taxa, many individuals). VAN LEEUWEN (1966) called this border situation a *limes convergens* (= ecotone). A number of taxa that are bound to such borders, are assigned to the Agropyro-Rumicion crispi, an alliance of the order Plantaginetalia majoris. This order is classified into the class Plantaginetea majoris. WESTHOFF & DEN HELD (1969) state that some taxa are characteristic of transitions between, or contacts with Agropyro-Rumicion crispi associations, and other units. Where the Littorelletea are concerned (Littorellion in WESTHOFF & DEN HELD). *Veronica scutellata* and *Ranunculus flammula* are mentioned as such taxa, as well as some other taxa that are rare in the present tables.

II.2 Nomenclature

For the names of phanerogams and pteridophytes the flora of HEUKELS & VAN OOSTSTROOM (1970) is followed. *Eriocaulon septangulare* is taken from CLAPHAM, TUTIN & WARBURG (1962). Drs. F. Adema from the Rijksherbarium of Leiden kindly provided me with the correct names of some taxa that occur in the French relevés. The names of Musci, except the Sphagnaceae, are taken from VAN DER WIJK et al. (1959-1969), the names of Sphagnaceae from ISOVIITA (1966) and the names of Hepaticae from

MULLER (1957). Characeae were determined from MAIER (1972).

For the names of syntaxa the proposed rules of nomenclature of RAUSCHERT (1963) and MORAVEC (1968) have been applied as much as possible and when it was appropriate. In some cases a rigorous application of the rules created situations, against which the rules have been erected. Moreover, the rules are not binding, as they have not (yet) been accepted by any authoritative international scientific organization such as an International Botanical Congress.

II.3 Water analyses

In the first year of the investigation (1968) all water analyses were executed in the laboratory. Samples were collected in polyethylene bottles. pH was measured with a regular electrical laboratory pH meter, and the electrical resistance with an electrical conductivity meter (Philips PR 9500). These measurements were carried out as soon as possible after the samples were taken. Cl^- was determined after MOHR (in SKOOG & WEST 1963). The ions K^+, Na^+ and Ca^{2+} of the samples collected in 1968 were measured flame-photometrically in the laboratory of Internal Medicine of the University of Nijmegen with the kind permission of Dr. A.P. Jansen. When not used immediately, the samples were kept in polyethylene bottles at room temperature. Beginning in 1969, pH was measured in the field, with a portable pH-meter (Metrohm E 444). In moorland pools pH is usually rather instable because of the low buffering capacity of the water. It is therefore preferable to measure pH on the spot.

The amounts of Cl^- and Ca^{2+} in the samples collected from 1969 were measured in an auto-analyzer (Technicon). Since most samples were collected some time before these analyses could be executed, the samples first had to be checked to detect if they had changed during that time. For this purpose the electrical resistance was measured again, and compared with the formerly obtained value. If no or only a slight difference with the previous value was observed, the sample was considered unchanged, and the amounts of Cl^- and Ca^{2+} were measured in the auto-analyzer.

An objection to this way of checking is that only the total ion concentration is considered, whereas no account is taken of shifts in the concentration of the components in the solution. Apart from the fact that under the circumstances no other check was possible, one must take into consideration, that every water sample only represents a moment, both in time and in space, of the total situation in the pool or lake. Some factors vary strongly during a given season, or with the time of day, or location (GREMMEN & KREMERS 1971).

The results of the water analyses are rendered in the legend of the relevés.

II.4 Soils

In studies of the aquatic vegetation more attention is usually focused on the chemical qualities of the water rather than on those of the soil, in spite of the fact that not only the physical, but also the chemical qualities of the soil are of importance for rooted aquatic plants, and that physical and chemical qualities of water and soil often show only a weak relation to each other (OLSEN 1950). Since there is some relation, however, and since water analyses are easier to execute and to interpret and are less time consuming than soil analyses, water analyses are executed far more frequently than soil analyses. This is also the case with the present study.

Although every relevé made by the present author, and most of the remaining relevés, are provided with soil data, these do not give quantitative information. No soil analyses have been executed; the content of organic matter and the grain size have not been determined. All soil data collected by W.H. Diemont, G. Sissingh, the S.O.L.investigators, V. Westhoff and the present author are based on visual observation.

In order to avoid quasi exactness, only a few terms will be used to describe the soils of the relevés. These terms are gravel, sand, mud and organic matter. The term *gravel* has been used when the soil consists of small stones; the term *sand* when the grains have the size of what is commonly meant by sand. The term *mud* has been used for all very fine grained soils; it includes clay, loam, silt and humus. The terms clay and silt refer to particular grain sizes, which were not determined in the present study, whereas „loam" is a complex concept. Therefore, the general term *mud* had been applied. Also, this term is not meant to give information about the organic content of the soil. Organic matter has only been mentioned where it could be obviously detected, for example from plant remains.

Other soils come up in the text incidentally, when their occurrence has been demonstrated by others.

No distinction has been made between autochthonous (produced in the lake or pool itself) and allochthonous (produced elsewhere) organic matter. In addition no distinction has been made between peat and humus.

General data about sub-aqueous soils are published by KUBIENA (1953) and SPENCE (1964).

Chapter III

CLIMATE

The climate of all investigated areas is influenced strongly by their closeness to the sea, it is, therefore, a humid and temperate climate In all areas westerly winds prevail

In The Netherlands the mean annual temperature is 10 2°C, with a temperature amplitude of about 15° The mean temperatures of the warmest months, July and August, are 16 5 and 16 7°, these temperatures increase from the coast into south east direction Mean maximum temperatures for July reach values between 18 8 and 23 1° The mean temperature of the coldest month, January, is 1°, it decreases from south west to north east The mean maximum of that month is 3 4-5 0° During 59 days of the year a minimum temperature below 0°C is recorded

The highest precipitation is recorded from Vaals (863 mm/year), the lowest from Venlo (587 mm/year), whereas the standard precipitation (at De Bilt) is 760 mm/year Most rain falls in summer and autumn

Prevailing winds are westerly and south westerly (LABRIJN 1945, MULDER 1949)

In Artois mean annual temperature is 10 2°C at Boulogne, with a temperature amplitude of 12 9° Mean maximum temperature of the warmest month, August, is 19 9°, mean minimum temperature of the coldest month, January, is 2°

Precipitation is on the average 768 mm per year, there are 152 days with rain May and June are the driest months, whereas most rain falls in October and November

The prevailing westerly winds blow chiefly in spring and summer (SANSON 1961 in WATTEZ 1968)

In Brittany mean annual temperature is 11 6°C at Roscoff (on the coast) and 11 9° at Rennes (inland) Temperature amplitude in the province of Finistere is less than 10° Temperatures below 0° are measured during less than 10 days per year at Roscoff.

Precipitation is 800-1000 mm per year in Finistère, and 600-700 mm per year on the north coast of Brittany (SANSON 1945 in GÉHU 1964). In TOUFFET (1970) annual precipitation data are given from Plélan: 834 mm per year, Ploermel: 696 mm per year and Rennes: 669 mm per year.

Westerly winds prevail in Brittany; south westerly winds are the most frequent.

In Les Landes (data from VANDEN BERGHEN 1969) mean annual temperature of Cazaux, situated in the middle of the chain of lakes, is 12.9° C, with a temperature amplitude of 13.9°. Mean maximum temperature of the warmest months, July and August, is 25.5°; mean minimum temperature of the coldest month, January, is 2.3°. A temperature of 0°or lower is measured during 40 days per year, whereas there are 16 days with temperatures above 30°.

Precipitation values, from north to south, are 941 mm per year at Lacanau, 931 mm per year at Cazaux, 1010 mm per year at Mimizan and 1157 mm per year at Dax. Most rain falls in November and December.

As in the preceding regions prevailing winds come from the west (south west, west and north west).

In Scotland a mean annual temperature of 7.8-10° C is measured along the coast; localities situated more inland have a mean annual temperature between 5.6 and 7.8°. In the mountains temperatures are still lower. The same temperatures are measured in the Lake District, along the coast and inland respectively. Temperature amplitude has values between 8.9 and 10° along the west and north coast of Scotland; more inland it is 10-11.1°, as in the Lake District. Mean maximum temperatures for July are 16.1-17.2° along the Scottish west and north coast, and 17.2-18.3° more inland; in the Lake District the mean maximum temperatures for July vary between 18.3 and 19.4°. Mean minimum temperature of January is 0.6-1.1° in the north of Scotland and in the Lake District. The maximum and minimum temperatures are corrected to sea level, in order to eliminate the factor of altitude. Since, however, altitude far outweighs latitude, the corrected temperatures do not illustrate the actual situation, but these data yield comparative data.

Rainfall in the north of Scotland reaches values between 1000 and 1500 mm per year; in some locations along the north west coast 1500-2500 mm per year is measured. In the Lake District the coastal area receives 1000-1500 mm per year, whereas further inland 1500-2500 mm per year is measured, and in some places up to 2500-3750 mm per year. In most of the visited part of Scotland there are, on the average, 225-250 rain days per year, in the Lake

District there are 200-250 days of rain.

Prevailing winds are southerly, south westerly or westerly.

Mean annual temperature in Ireland is 7.8-10° C. Temperature amplitude is 7.8-8.9° along the coast of Galway, and 8.9-10° in the remaining areas visited. Mean maximum temperatures for July are 17.2-18.3° in the broad coastal area, and 18.3-19.4° in most of the inland areas. Mean minimum temperatures for January are 2.2-3.3° (as it is in Les Landes!) along the coast, 1.1-2.2° more inland, and less than 1.1° in the central part of the island. As in Scotland, maximal and minimal temperatures have been corrected for the factor of altitude.

The coastal areas of Galway and Donegal receive 1500-2500 mm of rain per year and the other visited areas 1000-1500 mm per year. In Galway and Donegal there are over 250 days of rain; in the other areas there are 225-250 days of rain.

Winds are mainly south westerly or westerly.

All climatic data mentioned from the British Isles are taken from TANSLEY (1949).

The climatic differences of the various regions are: temperature increases from north to south on the continent; annual temperature amplitude decreases from east to west; precipitation increases from east to west.

An atlantic climate is characterized by many factors including high precipitation, which falls mainly in summer and autumn, and low annual temperature amplitude. The atlantic character is the weakest in the climate of The Netherlands, in comparison with the other regions that are involved in the investigation; annual temperature is highest and precipitation lowest. Western Ireland, western Scotland, the Lake District and Brittany have the most „atlantic" climate. In The Netherlands and, to a less extent, in Artois, the influence of the Atlantic Ocean is diminished by Great-Britain. In Les Landes precipitation is highest in autumn, whereas the summers are dry; this is characteristic of a mediterranean climate.

The mutual climatic differences are small, however, and it is therefore not appropriate to apply a classification of climates to the various regions, as is done by WALTER & LIETH (1960). It suffised to render the difference in words.

Chapter IV

GEOLOGY

The surface layers of The Netherlands are almost entirely of pleistocene or holocene origin Only in a few locations older layers break the surface. The pleistocene layers, occurring in the eastern part of the country, were deposited in times when cold climates prevailed, and as a result the vegetation was scarce As a consequence, glacial and aeolian deposits predominated These deposits consist mainly of sand, the so-called coversand, which occurs as an undulating cover on the subsoil In the greater part of Drenthe boulder clay is found approximately 1 m below the surface. In parts of North-Brabant the sand rests on loam deposited by brooks and wind

The erosive forces of glaciers, rivers and wind formed depressions in this sand, which became filled with water In some regions many such pools are found together, in other regions they are isolated The size of these pools usually does not exceed a few hectares They are usually shallow, not deeper than 1 5 m

Frequently these pools have originated from rivers or brooks Parts of the river Maas were blocked by ice mixed with sand, causing the river to change its course The Malpievennen in North-Brabant so originated, they are situated parallel to a former river bed of the Maas, which formerly was largely branched, the present river Dommel The Bergvennen and Lattropse vennen in Overijssel are remnants of stream gullies, which became partialy filled with coversand They clearly lie in rows (VAN DER HAMMEN 1961, VAN DER HAMMEN & WIJMSTRA 1971)

In North-Brabant a confluent to the river Bakelse Aa became blocked by coversand, and only one pool, the Bultven, remains from the former river (VAN DEN TOORN 1962)

Many pools developed where wind has blown away coversand during dry periods, therefore forming depressions These depressions became filled with water when the phreatic level rose, in other cases the bottom of the depressions rested on an impermeable layer (e.g. loam or boalder clay) and the resulting pools were independent of the phreatic level. The Oisterwijkse Vennen, the Huisvennen of Boxtel, the Hatertse and Overasseltse Vennen of Nijmegen are examples of such blown out pools created in this fashion (LORIÉ 1916-1919).

Pools with an iron-pan are less common. An iron-pan could be formed by a strong humus podzolization under moorland vegetation, leading to an impermeable layer (ZONNEVELD 1965, VOORWIJK & HARDJOPRAKOSO 1945, SCHIMMEL & TER HOEVE 1952).

Many pools have been originated by man, by digging activities, such as extraction of peat, loam or moorland plants. These pools usually have steep slopes and flat bottoms.

In Drenthe and south eastern Friesland many pools have originated from pingos. They developed when lens shaped ice pockets, buried in the soil, melted after the climate became warmer. They are characterized by a circular shape and have walls of boulder clay (MAARLEVELD & VAN DEN TOORN 1955).

The dunes of Artois, just as the „old dunes" in The Netherlands, were formed during the late Atlanticum and the Subboreal (Holocene), from marine deposits. In places where the wind has blown away sand down to the phreatic level, valley pools resulted. Such pools are well represented in the dunes between Berck and Merlimont (WATTEZ 1968).

In Brittany very old layers reach the surface, many of them of Precambrian age (RUTTEN 1969), usually giving rise to acid, silicious and poorly permeable soils. This factor, in combination with the humid climate, make this region well suited for the development of oligotrophic pools, which are indeed scattered throughout Brittany (GÉHU 1964).

In Les Landes aeolic sands, those carried by sea-winds, were deposited beginning in the middle Pleistocene. Such sands have been deposited on top of layers derived from rocks eroded in Massif Central and the Pyrenees and deposited between the oligocene and lower Pleistocene. As a coherent range of dunes developed, the drainage of the land behind the dunes deteriorated. As a consequence, marshes developed behind the dunes eventually forming the present lakes (VANDEN BERGHEN 1969).

The Scottish Highlands consist of very hard Archaean metamorphic rocks, with large igneous intrusions, some of which are from the Tertiary period. Geomorphologically the region consists of high ground, intersected by deeply cut valleys and glens. During the Pleistocene an ice-cap covered the Scottish Highlands and removed the previously formed soils. When the ice retreated, a mantle of glacial drift covered a large part of the country. Boulder clay occurs in the Highlands only on the margins and in the lower parts of the great valleys, but well-developed moraines are found frequently. By the action of the ice many valleys were widened, lakes were dammed and streams were diverted. The development of many lakes was the result. The Archaean rocks, in which many lakes are situated, wheather very slowly, and give rise to oligotrophic lakes.

In the Lake District the same events have taken place as in the Scottish Highlands, but here the rocks are of Silurian origin (Skiddaw slates) in the north, and of Ordovician origin in the south. The glaciers have left large areas containing boulder clay.

In Ireland the central plain of Carboniferous limestone is enclosed by a circle of mountains, which are of Archaean or Palaeozoic age. Carboniferous rocks reach the surface in The Burren, Co. Clare. In the counties of Donegal, Mayo and Galway, where most of the research was done, Precambrian rocks reach the surface. Just as Scotland and the Lake District, Ireland was covered by an ice-cap during part of the Pleistocene. After the ice retreated, the western part became largely covered with blanket bog, and developed a very humid climate. In the same area many pools developed, most of them oligotrophic. However, in south western Connemara calcareous sands, formed mainly by foraminifera and nullipores, occur along the shore. The smaller particles are transported some distance inland by westerly winds and give rise to a calcicole vegetation, which differs strongly from the vegetation of the adjacent blanket bog (PRAEGER 1934).

All data about the geology of the British Isles are taken from TANSLEY (1949).

Chapter V

RESULTS: THE ASSOCIATIONS

V.1 Isoëto-Lobelietum (W. Koch 1926) Tüxen 1937

V.1.1 Introduction

KOCH (1926 described the association Isoetetum echinospori,*) according to the methods of the Zurich-Montpellier School As character taxa of the association KOCH considers *Isoetes setacea* (=*I echinospora* = *I tenella*), *Littorella uniflora* f *isoetides*, *Elatine hexandra* and *E hydropiper* Among the companions there are *Juncus bulbosus* f *confervaceus*, *Myriophyllum alterniflorum* and *Eleocharis acicularis* var *longicaulis* In western and northern Europe the association is enriched with *Lobelia dortmanna*, according to KOCH He also remarks that the association is restricted to water that is poor in lime, and occurs adjacent to the Eleocharitetum acicularis, in deeper water

The same association had been mentioned by ALLORGE & DENIS (1927), OBERDORFER (1934), CHRISTIANSEN (1935) and by other phytosociologists who's work will be mentioned later JONS (1934) was the first person to publish releves of the association, they represent the „enriched" association, to which KOCH (1926) had pointed since *Lobelia dortmanna* is present in the releves *Isoetes lacustris* is found instead of *I setacea*

TUXEN (1937) changed the name of the association into Isoeto-Lobelietum This name fits better the association than the name Isoetetum echinospori, since *Lobelia dortmanna* is far more frequent than *Isoetes setacea* and *I lacustris* In many localities of *Lobelia dortmanna* no *Isoetes*

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* KOCH should have written Isoetetum echinosporae instead of Isoetetum echinospori, since the name is given after *Isoetes echinospora*

species is found, whereas in *Isoetes* sites *Lobelia dortmanna* is often present. In TÜXEN 's (1937) table of the association the genus *Isoetes* is represented by *I.lacustris*, but the present tables and tables published before show that *I.setacea* does occur in the association. The Isoeto-Lobelietum has been mentioned by ROLL (1939), LOUIS & LEBRUN (1942), BENNEMA et al. (1943), WESTHOFF et al. (1946), LEBRUN et al. (1949), TÜXEN (1955), ALTEHAGE (1957, 1960), DEN HARTOG & SEGAL (1964), DAMBSKA (1967) and WESTHOFF & DEN HELD (1969).

DIERSSEN (1972) used the name Lobelietum dortmannae (Osvald 1923) Tx. 1970 MS.

BRAUN-BLANQUET & TÜXEN (1952) described a vicariant association from Ireland, which was named Eriocaulo-Lobelietum Br.Bl. et Tx '52; this association got a broader conception by SCHOOF-VAN PELT & WESTHOFF (1969) and was called Eriocauletum septangularis Br.Bl et Tx. '52 em. Schoof-van Pelt et Westhoff by the latter authors. VANDEN BERGHEN (1969a) described from south western France a Scirpeto-Lobelietum Vanden Berghen '64, the name of which he changed into Isoeto boryanae-Lobelietum dortmannae Vanden Berghen '69 (VANDEN BERGHEN 1969a). PIETSCH (1965) distinguished two new *Lobelia dortmanna* associations: the Charo-Lobelietum and the Junco (bulbosi)-Lobelietum.

The Isoetetum echinosporae, the Isoeto-Lobelietum, the Eriocaulo-Lobelietum and other *Lobelia dortmanna* associations are mentioned in the surveying publications on the vegetation of fresh waters by OBERDORFER (1957), MULLER & GORS (1960), PASSARGE (1964), SEGAL (1965, 1968), PIETSCH (1965, 1971 MS), RUNGE (1966, 1969) and OBERDORFER et al. (1967).

Most phytosociologists have classified the various associations in question into the Littorellion: KOCH (1926), JONS (1934), OBERDORFER (1934, 1957), CHRISTIANSEN (1935), TUXEN (1937, 1955), ROLL (1939), LOUIS & LEBRUN (1942), BENNEMA et al. (1943), WESTHOFF et al. (1946), BRAUN-BLANQUET & TUXEN (1952), ALTEHAGE (1957, 1960), MULLER & GORS (1960), DEN HARTOG & SEGAL (1964), PASSARGE (1964), SEGAL (1965, 1968), RUNGE (1966, 1969), DAMBSKA (1967), OBERDORFER et al. (1967), SCHOOF–VAN PELT & WESTHOFF (1969) and WESTHOFF & DEN HELD (1969).

LEBRUN et al. (1949) consider the Helodo-Sparganion the only alliance within the Littorelletalia, and they have classified the „association à *Isoètes lacustris* et *Lobelia dortmanna*" into it.

PIETSCH (1965, 1971 MS) and VANDEN BERGHEN (1969a) have classified their *Lobelia dortmanna* associations into the Lobelio-Isoetion, VISSER & ZOER (1972) did the same with their *Lobelia dortmanna* relevés, although these have not been classified into an association

According to DIERSSEN (1972) the *Lobelia dortmanna* association belongs to the Myriophyllo-Lobelion

The *Lobelia dortmanna* and *Isoetes*-communities are well developed in the British Isles and especially in Scandinavia, but since the British and Scandinavian phytosociologists do not use the same criteria as the Zurich-Montpellier-phytosociologists in classifying vegetation, their vegetation units are not directly comparable with the units of the latter system

V. 1.2 The present relevés

Tables 1-6

The relevés have been made by W Diemont, G Sissingh, V Westhoff, the S O L investigators and the present author The following units can be distinguished within the association

I impoverished subassociation, Isoeto-Lobelietum inops
  Ia strongly impoverished variant
  Ib moderately impoverished variant
II subassociation of *Myriophyllum alterniflorum*, I -L myriophylletosum alterniflorae
III subassociation of *Isoetes setacea*, I -L isoetetosum setaceae
IV subassociation of *Isoetes lacustris*, I -L isoetetosum lacustris
V subassociation of *Subularia aquatica*, I -L subularietosum aquaticae
VI subassociation of *Sphagnum* species, I -L sphagnetosum
VII subassociation of *Eleocharis multicaulis*, I -L eleocharetosum multicaulis

The Netherlands

The tables 1, 2 and 3 will be elucidated in chronological sequence

Table 1, relevés made by W Diemont and G Sissingh in 1936-1943

The variant Ib and the subassociations III, IV, V and VII are represented in this table

The moderately impoverished variant (Ib) is represented by relevés 1-3, and it can be characterized by *Lobelia dortmanna*, *Juncus bulbosus* and *Littorella uniflora* In rel 2 species such as *Phragmites australis* and *Carex* *lasiocarpa* bring about an autogenic succession. The sandy substrate was mixed with organic matter in some stands.

Releves 4-8 represent the subassociation of *Isoetes setacea* (III), *Isoetes setacea* is the only differential taxon. Only one releve is derived from pure sand, the other relevés are derived from sand mixed with mud or with organic matter. *Nitella* sp. is present in two releves.

In the subassociation of *Isoetes lacustris* (IV, releves 9-18) *Luronium natans* and *Elatine hexandra* are differential taxa, apart from *Isoetes lacustris*, at least in the table of releves that are made by W. Diemont and G. Sissingh. Almost alle releves are derived from a sandy soil, contrary to the releves from the former subassociation.

The constant taxa of the subassociation of *Sphagnum* species (VI rel. 19-31) are *Lobelia dortmanna, Juncus bulbosus, Littorella uniflora, Sphagnum cuspidatum* and *Drepanocladus fluitans*. *Sphagnum* section *Subsecunda* is represented in almost every releve by *Sphagnum crassicladum, S. inundatum, S. contortum* or *S. inundatum*. Differential taxa can be considered *Sphagnum cuspidatum, S.* sect. *Subsecunda* and *Gymnocolea inflata*. The latter species is possibly identified incorrectly. It may be *Cladopodiella fluitans*, a liverwort of oligotrophic waters. *Gymnocolea inflata* is found mostly on humid, oligotrophic sites. See AGSTERIBBE et al. (1950). The releves are derived from sheltered sites (as far as data about the sites are known) and from shallow pools. There is a sandy soil usually, but in some stands the sand is covered by a layer of mud.

Eleocharis multicaulis is the differential taxon in the subassociation of *Eleocharis multicaulis* (VII, releves 32-42), other character taxa of the Eleocharetum multicaulis are hardly present. This subassociation represents the most homotonous (after NORDHAGEN as cited by DAHL (1956)) part of the table. In any of the stands the water was never deeper than 30 cm. The soil was sand or sand covered with mud or organic matter.

Table 2, releves made by the SOL-investigators in 1957-1959.

The variant Ib and the subassociations III, IV, VI and VII can be seen in this table.

Releves 1-14 represent the moderately impoverished variant (Ib) The number of taxa is low and there are few companions *Luronium natans* is most frequent in this subassociation, whereas in table 1 it is a differential taxon of the subassociation of *Isoetes lacustris* *Eleocharis palustris* ssp *palustris*, *Sphagnum crassicladum* and algae are the most fequent companions

In most stands the water depth was considerable, even in summer, the average depth in the releves 1-10 was a good 50 cm It is therefore unlikely that these stands run dry in summer The great water depth may be held responsible for the bad representation of the companions

In most stands a sandy soil was observed, and in some stands the sand was covered with or mixed with organic matter

The subassociation of *Isoetes setacea* (III) is represented by 3 releves (14-16), all from the same pool The subassociation can be characterized by *Isoetes setacea* and *Drepanocladus fluitans* The latter species is also frequent in the same subassociation in table 1 *Lobelia dortmanna* is absent, it has not been observed in the pool for long, but this species used to occur there It is not known however, whether *Lobelia dortmanna* and *Isoetes setacea* occurred in the same site

The combination of *Isoetes setacea* and *Peplis portula* (rel 16) is exceptional

This subassociation was observed on a sandy soil of which the top layer is mixed with organic matter

Relevés 17 and 18 show the subassociation of *Isoetes lacustris* (IV), both releves are derived from the same pool They differ in floristic respect strongly from the same subassociation in table 1, by the absence of *Luronium natans*, *Elatine hexandra* and companions The soil is also different in the stands reported in this table the sand is covered with 15 20 cm of organic matter, whereas it is pure sand in the stands reported in table 1 The isoetid species usually do not grow on weak soils, probably since their leaves could easily get covered by the soil particles, making assimilation impossible The releves in question thus demonstrate an unusual habitat

The subassociation of *Sphagnum* species (VI) can be seen in relevés 19-30 The bryophytes, which cover together over 10% of each stand, are represented by *Drepanocladus fluitans*, *Sphagnum crassicladum*, *S cuspidatum* and *Cladopodiella fluitans* In two releves (27 and 29) *Gymnocolea inflata* is mentioned, but it may have been identified incorrectly The liverwort probably is *Cladopodiella fluitans.* The water depth is over 20 cm in most relevés and the soil consists of sand or sand with a top layer of organic matter. The concomitant presence of *Lobelia dortmanna* and *Littorella uniflora* with bryophytes is not beneficial to the former species, since the bryophytes intercept light. Therefore this subassociation usually does not represent a stable situation. If the surface covered by the bryophytes expands, the isoetids species are doomed to vanish. Only if the bryophytes are kept under control (e.g. by moderate wave action) can this subassociation reach an equilibrium situation.

ALTEHAGE (1957) mentions the occurrence of the Isoëto-Lobelietum in north western Germany. The vegetation seems to follow a succession towards communities which are rich in *Sphagnum* species, due to a changing habitat. The development of mosses stops or decreases, however, if the vegetation runs dry. Species such as *Lobelia dortmanna* and *Littorella uniflora* are adapted to an amphibious life, so they can stand a temporary existence as land plants. In the case of relevés 20, 21, 22, 23, 24, 25, 27, 29 and 30 there was some kind of wave shelter (trees, reeds). Conditions of strong wind and waves enhance the competitive ability of the Isoëto-Lobelietum. In very shallow pools the wind does not exert enough influence to destroy the bryophytes, once they have settled (relevés 26 and 30). In the pool of rel. 29 the water level was raised in 1950; many pieces of vegetation were loosened by this intervention and became the base for a floating bryophyte vegetation.

The subassociation of *Eleocharis multicaulis* (VII, relevés 31-35) is characterized by *Eleocharis multicaulis,* which is present in all relevés, and by *Echinodorus repens* and *Hypericum elodes,* which are present in some relevés only. The Phragmitetea are represented with 5 taxa, whereas bryophytes are almost lacking. The waterdepth nowhere exceeds 30 cm and the soil is sandy.

Tabel 3, relevés made by the present author in 1967-1970

Only 15 relevés of the present author represent the Isoëto-Lobelietum; they can be classified into variant Ib and subassociations III, VI and VII.

Three relevés (1-3) show the moderately impoverished variant (Ib); they are poor in species. The stands are not likely to run dry in summer, as a water depth of 15-50 cm was observed (in summer). The soil is sandy, in one stand the sand is covered with a thin layer of mud.

In the stand of rel. 1 a pH of 4.3 was measured, which is rather low. In the stand of rel. 2 pH-measurements all over the year are available; the pH usually had a value between 6 and 8, occasionally higher. The electrical conductivity measurements show values between 140 and 320 μS, 10-18 mg Ca^{2+}/l was measured, and 25-40 mg Cl^{-}/l.

The subassociation of *Isoëtes setacea* (III) is represented by two relevés (4 and 5), taken from the same pool as relevés 14-16 in table 2.

Luronium natans was not observed in the relevés of table 2. Aside from this exception the relevés of this subassociation are more or less similar to those reported in table 2. The soil was a muddy sand and the water had a pH of 4.7-5.0, an electrical conductivity of 170 μS, 11 mg Ca^{2+}/l and 22 mg Cl^{-}/l.

In relevés 6-8 the subassociation of *Sphagnum* species (VI) is noted. In two relevés *Sphagnum crassicladum* was the dominant moss, in one relevé the dominant moss was *S. cuspidatum.* In one stand the water was below surface; in the others it was 15-20 cm above surface. In one stand the sandy soil was covered with organic matter. Two water analyses, from the same little pool, gave pH-values of 4.5 and 6.1 and an electrical conductivity of 107 and 75 μS, respectively.

Most relevés represent the subaccociation of *Eleocharis multicaulis* (VII, relevés 9-15). The majority of them is derived from the „Beuven", as in table 2; and in both tables there is one relevé from the „Taamven".

The sandy soil was covered with a thin layer of mud in most cases, but in the stand of rel. 9 there was a thick layer of mud above the sand. In the stand of rel. 9 during the year a pH of 6-7 was measured, an electrical conductivity of 178-256 μS, 6-11 mg Ca^{2+}/l and 22-27 mg Cl^{-}/l. The variation of the pH and other factors in the „Beuven" (relevés 10-15) is rendered at rel. 2 of this table.

Some pools are represented by relevés in the tables 1, 2 and 3. The „Beuven" is reported in table 1 in relevés 9, 12, 14, 16 and 18, all of which belong to the subassociation of *Isoëtes lacustris.* In table 2 rel. 3 represents the moderately impoverished variant, and relevés 32, 33 and 35 represent the subassociation of *Eleocharis multicaulis.* In table 3 the same units are represented, in rel. 2 and in the relevés 10-15 respectively. *Juncus bulbosus* is rare in the relevés of table 3.

The „Flaas" is seen in table 1 in rel. 38 (subassociation of *Eleocharis* *multicaulis),* in table 2 in rel. 13 and in table 3 in rel. 3 (both moderately impoverished variant).

The „Bergvennen" are represented in the relevés 25,26,35 and 36 in table 1 (subassociation of *Sphagnum* species and subassociation of *Eleocharis multicaulis*), in the relevés 20, 21 and 22 in table 2, and in rel. 7 in table 3 (both subassociation of *Sphagnum* species). The most striking fact is the difference between the relevés made by W. Diemont (25 and 26) and the relevés made by G. Sissingh (35 and 36) from the same „Bergvennen", especially as concems the bryophytes.

France

Table 4

Only four relevés represent the Isoëto-Lobelietum. Two of them can be classified into the moderately impoverished variant (Ib, relevés 1 and 2). *Trapa natans* is a conspicuous species in these relevés. This thermophilic species used to occur farther north and west, as can be concluded by the occurrence of fossilized remains. When the climate became cooler, the species retreated to its present area. The distribution area of the species can be seen in WALTER & STRAKA (1970 page 179).

There were 50 cm of water above the sandy soil. The relevés are derived from the central part of the lake, where the vegetation remains open by means of wind and waves and also by man's activities in watersport. No water analyses are available from the sample plots; the values shown in the legend, are taken from a site near the shore.

In relevés 3 and 4 the subassociation of *Eleocharis multicaulis* (VII) is represented. *Myriophyllum alterniflorum* has envaded from the deeper water. Since the shore is rather steep, the vegetation belts with *Eleocharis multicaulis* and *Myriophyllum alterniflorum* are telescoped a little. In rel. 4 the sandy soil was covered with a thin layer of mud, in rel. 3 it was pure sand. In rel. 3 the water was 50 cm deep, which is exceptionally deep for *Eleocharis multicaulis.*

Scotland and England

Table 5

The relevés represent variant Ib and subassociations II, III, IV, V and VII.

Relevés 1-7 can be classified into the moderately impoverished variant (Ib); most of them consist of only three species: *Lobelia dortmanna, Juncus bulbosus* and *Littorella uniflora.* The only English relevé is derived from an organic soil. In the other relevés the soil consisted of sand or gravel, in some stands covered with a thin layer of mud. Since all stands were situated more or less exposed to wind and waves, the mud could not permanently cover the leaves of *Littorella uniflora* and *Lobelia dortmanna.* The water was shallow, usually between 5 and 10 cm. A circumneutral pH was measured, and the electrical conductivity was determined to be between 51 and 116 μS. The values for Cl^- and Ca^{2+} were low.

The subassociation of *Myriophyllum alterniflorum* (II) can be seen in relevés 8-16. The floristic difference with the former syntaxon consists of the presence of *Myriophyllum alterniflorum* in the relevés. An ecological difference is observed in the water depth, which is greater, generally speaking, in these stands than in the former syntaxon, and which reaches a maximum value of 50-60 cm.

The soils of both syntaxa are similar, and so are the chemical properties of the water.

The subassociation of *Isoëtes setacea* (III) is represented by relevés 17-20. They can be distinguished from Dutch relevés of this subassociation by the absence of *Drepanocladus fluitans.* In Scotland this subassociation was observed on a gravel and sand mixture, in 10-20 cm of water.

The water analysis at rel. 18 is more or less applicable to relevés 19 and 20, as they are all derived from the same little pool. The high Cl^- content (41 mg/l) is due to its proximity to the sea. The electrical conductivity of 203 μS is high in comparison with values found in the two former syntaxa; it is similar to the value of 220 μS found by SEDDON (1965) in a eutrophic Welsh lake in which *Isoëtes setacea* was found. SEDDON (1965) measured 52 mg Ca^{2+}/l, whereas I measured only 3.6 mg/l.

The subassociation of *Isoetes lacustris* (IV, relevés 21-24) is much poorer in species than the same subassociation in table 1. *Luronium natans* and *Elatine hexandra* are absent, as well as almost all companions.

In three stands the water depth does not exceed 30 cm; in one stand 50 cm was noted. The soil was composed of gravel, in some stands sand or mud was found in between the gravel.

The pH of the water was circumneutral, whereas the electrical conductivity measurements showed rather low values (63 μS in rel 23 and 51 μS near to relevés 22 and 24) and one rather high value in rel. 21 (203 μS). The pool of rel. 21 is situated close to the sea and shows a rather high Cl^- content (44 mg/l).

The only Scottish relevé of the subassociation of *Subularia aquatica* (V, 25) is derived from the shore of a small river, where the site was sheltered from fast running water by a dense growth of *Carex rostrata*, and where fine mud precipitates. In the very shallow water a slightly acid pH was measured, an electrical conductivity of 65 μS, 11 mg Cl^-/l and 2.7 mg Ca^{2+}/l.

In the subassociation of *Eleocharis multicaulis* (VII, relevés 26-37) two variants may be distinguished; an impoverished variant (relevés 26-32) and a variant of *Scirpus fluitans* (relevés 33-37). The impression is given that the latter variant is found in a richer habitat than the former. This is suggested by the results of the water analyses and also by the total vegetation of the pools. The relevés are derived from sheltered sites: quiet bays of large lakes, or little pools, where there is a reduced wind- and wave-activity. The pH-values, measured in the sites of the impoverished variant, showed values between 5.3 and 6.2. The electrical conductivity values were of the same order of magnitude as in the other syntaxa, and so were the values for Cl^- and Ca^{2+}.

In the *Scirpus fluitans* variant the electrical conductivity was much higher than the average, viz. 203 and 252 μS, and a pH of 8.0 was measured in some stands. These high values are partly due to the proximity to the sea, which caused a high Cl^- content of the water in these pools.

Rel. 30 is derived from the same pool as rel. 33, in which a high pH, electrical conductivity and Cl^- content have been measured. *Scirpus fluitans* is present in rel. 33. In the stand of rel. 30 there is only some water in footprints, and the soil is very different, so that there may prevail different habitat conditions, which may be responsible for the lack of *Scirpus fluitans*.

Relevés 32 and 34, belonging to two different variants, are derived from the same site. It is not clear in what respect the habitats differ. Stands of the subassociation of *Eleocharis multicaulis* have a heavier muddy soil than those of the other subassociations.

Ireland

Table 6

Variants Ia and Ib and subassociations II, III, IV, V and VII are represented in the table. Some of these relevés were published before in a synoptic table in SCHOOF–VAN PELT & WESTHOFF (1969)

The Irish relevés can be distinguished from the remaining European relevés by the presence of *Eriocaulon septangulare* This amphi-atlantic species has its main distribution in North America In Europe it is found mainly in western Ireland, and in some western Scottish islands

Relevés 1-7 represent the strongly impoverished variant (Ia), which was only encountered in Ireland Character taxa of class, order and alliance are missing, but *Lobelia dortmanna* and *Eriocaulon septangulare* are present in all relevés The vegetation is derived from rather extreme habitats the water depth is considerable, in most stands over 50 cm or more Most stands lie strongly exposed to wind, which implies heavy water movement Some relevés are derived from an abnormal soil (organic or floating substrate) instead of sand or gravel In addition, the shore is very steep in some pools, and shallow water species are, therefore, absent

The water was acid to circumneutral, and the two measurements of the electrical conductivity showed values of 78 and 126 μS, which is not very high

More relevés are avaible of the moderately impoverished variant (Ib, releves 8-22) than of the strongly impoverished variant The most important species are *Lobelia dortmanna, Eriocaulon septangulare* and *Juncus bulbosus*, present in all or almost all releves *Littorella uniflora* is rare in this variant, in comparison to the releves presented in the other tables

The occurrence of *Apium inundatum* and *Echinodorus ranunculoides* in Ireland usually coincides with slight eutrophication It is probably caused by cattle (releves 11, 12, 14 and 21), or by the wind carrying salts from the sea or from the beach into pools (relevés 12, 17 and 21) In south western Connemara calcareous sands occur along the shores, formed mainly by nullipores and foraminiferae (PRAEGER 1934) In the relevés without *Apium inundatum* or *Echinodorus ranunculoides* (except rel 12 which is derived from the same pool as rel 21) no eutrophicating agents could be detected In quiet waters with organic or mud soil *Ranunculus flammula, Hydrocotyle vulgaris, Carex nigra, Utricularia intermedia, Menyanthes trifoliata* and *Molinia caerulea* are frequent, and a succession towards communities belonging to the Parvocaricetea can occur

A great variety of water depths was found in this variant, some soils stay inundated the entire year, others run dry only in exceptionally dry years, whereas still others run dry every summer Most relevés are derived from an organic soil, but mud, gravel and sand soils were found as well. In most stands the water was circumneutral, but in one stand a pH of 5.4 was measured. Three mesurements of the electrical conductivity are available; they showed values of 60, 113 and 126 μS. The Ca^{2+} content was low, the Cl^- content low or medium (12, 26 and 29 mg/l). *Littorella uniflora* was absent on most organic soils.

In three relevés (23-25) the subassociation of *Myriophyllum alterniflorum* (II) is represented. The Irish relevés are richer in taxa than the Scottish ones; in Scotland the highest number of taxa was 5, whereas this was the lowest number in Ireland. This is due to a greater number of Littorelletea taxa and to a greater number of companions in Ireland. *Equisetum fluviatile* is present in all three relevés. The water depth has values between 5 and 30 cm. This subassociation was found on gravel or sand soils, in circumneutral water.

The subassociation of *Isoëtes setacea* (III) is seen in relevés 26 and 27. Just as in the Scottish relevés belonging to this subassociation, *Drepanocladus fluitans* is missing, as opposed to the Dutch relevés. The subassociation was found in circumneutral water of 20-60 cm depth, and on an organic soil.

The subassociation of *Isoëtes lacustris* (IV) is represented by relevés 28-30. They are derived from a sand or gravel soil, from depths of 10-50 cm. In one relevé *Fontinalis antipyretica* is present, just as in one Scottish relevé and in one relevé in table 1. The electrical conductivity of the water did not reach values as high as in the Scottish stands, viz. 113-133 μS; the Cl^- content was rather high (26,30 and 53 mg/l). One pH measurement gave a value of 6.7.

The subassociation of *Subularia aquatica* (V) is represented by 6 relevés (31-36); in one of them *Isoëtes setacea* occurs. Just as in Scotland they are derived from a fine mud soil. In two relevés both *Lobelia dortmanna* and *Eriocaulon septangulare* are absent. Some relevés are derived from 10-20 cm of water; others are derived from humid shores. The pH had slightly alkaline values, the values for electrical conductivity, Cl^- and Ca^{2+} are low.

In relevés 37-50 the subassociation of *Eleocharis multicaulis* (VII) is seen. Apart from *Eleocharis multicaulis* the following character taxa of the Eleocharetum multicaulis are present: *Potamogeton polygonifolius, Scirpus fluitans, Deschampsia setacea* and *Hypericum elodes.*

V. 1.3 Synecology

The average habitat of the *Lobelia dortmanna* associations is characterized by a sand or gravel soil, oligotrophic water and a fluctuating water level, rarely permitting the association to run dry These habitat factors have been mentioned by most phytosociologists GADECEAU (1909), PEARSALL (1920), KUPPFER (1925), KOCH (1926), JONS (1934), LOUIS & LEBRUN (1942), ISSLER (1942), BENNEMA et al (1943), WESTHOFF et al (1946), LEBRUN et al (1949), JOVET (1951), BRAUN–BLANQUET & TUXEN (1952), CORILLION (1953), OBERDORFER (1957), ALTEHAGE (1960), KLEUVER & VAN DER VOO (1962), PASSARGE (1964), SPENCE (1964), RUNGE (1966, 1969), VANDEN BERGHEN (1967, 1968, 1969a, in oligo-mesotrophic water), SCHOOF–VAN PELT & WESTHOFF (1969), WESTHOFF & DEN HELD (1969), ANDERSSON (1972), VISSER & ZOER (1972) and DIERSSEN (1972)

The association is reported from clay-loam by ANDERSSON (1971), from gravel mixed with loam by GADECEAU (1909), from dy by JONS (1934), from sand with a thin layer of mud by MORZER–BRUYNS & PASSCHIER (1943), from humous sand by OBERDORFER (1957), from peaty or silty sand by VISSER & ZOER (1972), from loam by WESTHOFF et al (1946) and from brown mud by SPENCE (1964) SCHOOF–VAN PELT & WESTHOFF (1969) have observed two variants on peat or sand, one on silt

Since the association cannot tolerate the leaves being covered with mud or organic matter, it is often found in the weatherside of the lakes and pools, an eventual layer of mud is not permanent in that case See for instance BENNEMA et al (1943), MORZER BRUYNS & PASSCHIER (1943) and ALTEHAGE (1960)

Grazing has been reported in the Isoeto Lobelietum by SCHOOF–VAN PELT & WESTHOFF (1969) and WESTHOFF (1969)

OSVALD (1923) mentions the association from „very deep water", whereas TUXEN (1937) had described it from shallow water

Mesotrophic water is mentioned by VANDEN BERGHEN (1964), who came to that conclusion by evaluation of the phytoplankton CHRISTIANSEN (1935) mentions oligotrophic water, poor in lime Several authors have executed water analyses JONS (1934) measured a pH of 6 4-6 6 NYGAARD (1938) described two lakes in which the same character taxa of the Isoeto-Lobelietum occurred, in one lake the pH was 4 3-5 4, and in the other lake it was 6 3-7 2 SPENCE (1964) measured the pH in three sociations of Isoeto-Lobelietum communities, the values are 6 7-8 0 in the „open *Litto-*

rella-Lobelia sociation", 6 8 in the „*Lobelia-Littorella* sociation" and 4 8-8 0 in the „*Littorella Juncus (bulbosus)* sociation" The alkalinity reached values of 28-57, 28-95 and 1-57 ppm $CaCO_3$ respectively The average values in the latter two coena are 5 (sic!) and 14 ppm $CaCO_3$ These values are regarded by SPENCE (1964) as representing water poor in nutrients VANDEN BERGHEN (1967) measured a pH of 6 5, 11 mg Ca^{2+}/l and 35 mg Cl^-/l in the same French lake, where I measured a pH of 7 1, 4 1 mg Ca^{2+}/l and 26 5 mg Cl^-/l (table 4) BEAUDRIMONT (1971) measured a pH of about 7 and 25-28 mg Cl^-/l in the same lake, the values for Ca^{2+} and for the electrical conductivity are indicated vaguely between 4 and 7 2 mg Ca^{2+}/l and between 75 and 150 μS electrical conductivity but they do not disagree with the values measured by the present author

In another French lake VANDEN BERGHEN (1968) measured a pH of 6 2-6 6, 55-65 mg Cl^-/l and 16-20 mg Ca^{2+}/l, I found a pH of 7 2, 34 1 mg Cl^-/l and 2 4 mg Ca^{2+}/l in the same lake

In a Swedish lake ANDERSSON (1971) measured an electrical conductivity of 100-120 μS, and 12-19 mg Cl^-/l

VISSER & ZOER (1972) noted in their Irish Lobelio-Isoetion communities a pH of about 7, an electrical conductivity of less than 100 μS and less than 10 mg Ca^{2+}/l

THUNMARK (1931) studied the vegetation of the oligotrophic Swedish lake of Fiolen The actual vegetation appeared to be influenced strongly by frost, which has a strong influence on the formation of the soil Up to a depth of about 50 cm the water freezes solidy on to the soil every year and the soil therefore undergoes strong erosion This part of the soil, the „erosive soil", is the habitat for *Isoetes setacea, Subularia aquatica* and other species *Lobelia dortmanna, Isoetes lacustris* and *Littorella uniflora*, on the other hand, are bound to „non erosive soil", which is found below the „erosive soil", there is a rather sharp border line between the two vegetation types

VAARAMA (1938 who studied the vegetation of a Finnish lake, arrived at the same conclusion except for one species *Lobelia dortmanna* did not seem to be bound to the „non erosive soil", but occurred in both the „erosive" and the „non erosive soils"

V. 1.4 Synchorology

The Isoeto-Lobelietum has a northern distribution in Europe This is due to the fact that the character taxa of the association *(Lobelia dortmanna, Isoetes* *lacustris, I setacea* and *Subularia aquatica)* are more frequently encountered in Scandinavia than in southern Europe (See Chapter VI where the distribution of these species is recorded)

In the northern countries the four mentioned species are commonly seen growing in one stand, whereas in countries that are situated more to the south usually one or more species are missing Communities, representing the Isoeto-Lobelietum, are mentioned from Sweden by OSVALD (1923), SAMUELSSON (1925), ARWIDSSON (1926), ALMQUIST (1929), THUN MARK (1931), STÅLBERG (1939), ANDERSSON (1971), WESTFELDT (1971), THORAN (1971) and OHLANDER (1971) The data of ARWIDSSON (1926) are derived from the northernmost part of Sweden (almost 67° North latitude)

In Finland the association has been mentioned by POHJALA (1933), LINKOLA (1933), MARISTO (1935), METSO (1936), VAARAMA (1938), and CEDERCREUTZ (1947) the northernmost locality is derived from METSO, 62° 40' North latitude

KUPPFER (1925) mentions the association from Estonia and Latvia In Norway the Isoeto-Lobelietum was mentioned by HOLMBOE (1930) and BRAARUD (1932) from a region between 63°30' and 64°30' North latitude

The association is quite common in Scotland WEST (1905, 1910), SPENCE (1964), the present work (fig 3), in England the association is found frequently in the Lake District, but without *Isoetes setacea* and *Subularia aquatica* (PEARSALL 1920, TANSLEY 1949, the present work, fig 3)

In Ireland the association is encountered mainly in the western part, it is enriched with *Eriocaulon septangulare* (PRAEGER 1934, BRAUN–BLANQUET & TUXEN 1952, WESTHOFF 1969, SCHOOF–VAN PELT & WESTHOFF 1969, VISSER & ZOER 1972, the present work, fig 3)

In Poland the Isoeto-Lobelietum is rather frequent (DAMBSKA 1967), *Isoetes setacea* and *Subularia aquatica* are missing In Denmark, north western Germany, The Netherlands, Belgium and France the association is rare, and never present with all four character taxa From Denmark it is mentioned by IVERSEN (1929), NYGAARD (1938) and JØRGENSEN (1950), from north western Germany by JONS (1934), CHRISTIANSEN (1935), TUXEN (1937), ROLL (1939), RUNGE (1966, 1969), ALTEHAGE (1957, 1960) and DIERSSEN (1972), from The Netherlands by SLOFF (1928), BENNEMA et al (1943), MORZER–BRUYNS & PASSCHIER (1943), WESTHOFF et al (1946), KLEUVER & VAN DER VOO (1962, WESTHOFF & DEN HELD (1969), the present work (fig 1), from Belgium by GOFFART, MARÉCHAL

& STERNON (1935), LOUIS & LEBRUN (1942) and LEBRUN et al. (1949); from France by GADECEAU (1909 and CORILLION (1953) (Brittany), ALLORGE & DENIS (1923), ALLORGE (1930), JOVET (1951), VANDEN BERGHEN (1964, 1967, 1968, 1969a), the present author (fig. 2), from Les Landes. In the last mentioned region *Isoëtes boryana* was present instead of *I.lacustris* or *I.setacea.*

In south eastern France a very fragmentary association was found with only *Isoëtes lacustris* and *I.setacea* by ALLORGE & DENIS (1927), and the same community was mentioned by OBERDORFER (1934) from south western Germany. In The Vosges *Subularia aquatica* and the previously mentioned *Isoëtes* species are found together (ISSLER 1942).

KOCH (1926) mentioned the very fragmentary association, consisting of only one character taxon *(Isoëtes setacea)* from northern Switzerland.

On the other side of the Atlantic Ocean a vicariant association is mentioned by GALIANO (1956) from Canada, and by WILSON (1935, 1941), JONES (1948) and WESTHOFF (1961) from the north eastern U.S.A.

V. 1.5 Discussion

KOCH (1926) remarks, in his description of the Isoëtetum echinospori in Switzerland, that the association plays a far greater part in northern and western Europe, where it is enriched with species such as *Lobelia dortmanna.* The Isoëtetum echinospori sensu KOCH is usually found outside the distribution area of *Lobelia dortmanna,* for instance in the Black Forest in south western Germany (OBERDORFER 1934) and in south eastern France (ALLORGE & DENIS 1927), where *Isoëtes setacea* and *I.lacustris* can be found in the same pool. In the Vosges *Subularia aquatica* was found together with the two *Isoëtes* species (ISSLER 1942).

In The Netherlands the communities, as described by KOCH (1926), were found in the „Groote Meer" (table 2, relevés 14-16, table 3, relevés 4-5). The situation is not quite comparable to the Swiss one, since *Lobelia dortmanna* did occur previously in the Dutch lake.

The community described by KOCH (1926) is in fact a fragmentary representative of the association Isoëto-Lobelietum sensu TÜXEN (1937). It cannot be considered an independent association, since it is distinguished from the Isoëto-Lobelietum sensu TÜXEN (1937) only by the absense of some association character taxa. Not even differential taxa are present to distinguish the Isoëtetum echinospori from the Isoëto-Lobelietum. The

Eriocauleto-Lobelietum Br Bl et Tx '52 is said to differ in many respects from the „northern European Isoeto-Lobelietum", from the „*Subularia-Isoetes* community" in south eastern France and in The Vosges, and from the Isoeteto-Sparganietum borderei Br Bl 1948 in the Pyrenees (BRAUN–BLANQUET & TUXEN 1952) The Irish association can be distinguished, according to the authors, from the above mentioned communities by the frequent occurrence of *Eriocaulon septangulare* and by the almost complete absence of *Subularia aquatica* The *Isoetes* species, especially *I lacustris*, are said to be far less frequent in Ireland than in the previously mentioned European regions These judgments are based on 12 relevés published by BRAUN- BLANQUET & TUXEN (1952) The erection of the Eriocauleto-Lobelietum in addition to the already mentioned communities can only be justified if the associations are mutually exclusive (vicarious) The authors claim *Eriocaulon septangulare* to be the geographically differential taxa of Ireland, whereas *Subularia aquatica, Isoetes lacustris* and *I setacea* are considered geographically differential taxa of the communities in the remaining part of Europe (BRAUN–BLANQUET & TUXEN 1952)

Eriocaulon septangulare indeed occurs only in western Ireland (and in a few western Scottish islands) The present tables show, however, that *Subularia aquatica, Isoetes lacustris* and *I setacea* are no rarer in Ireland than they are in Scotland (tables 5 and 6) As a consequence the communities occurring outside western Ireland which are mentioned by BRAUN–BLANQUET & TUXEN (1952), do not have geographically differential taxa Therefore, the Eriocauleto Lobelietum cannot be maintained any more in the rank of association

Eriocaulon septangulare has to be considered a character taxon and a geographically differential taxon of the western Irish Isoeto-Lobelietum

It cannot be agreed, therefore, that OBERDORFER (1957), MULLER & GORS (1960), SEGAL (1965, 1968) and OBERDORGER et al (1967) who accept various *Lobelia dortmanna* associations (the Isoetetum setaceae, the Isoeto-Lobelietum and the Eriocauleto-Lobelietum), are correct

The Eriocauletum septangularis Br Bl et Tx '52 em Schoof-van Pelt et Westhoff '69 cannot be maintained SCHOOF–VAN PELT & WESTHOFF (1969), in explanation of the Eriocauletum, asserted that there exist ecologically and floristically clearly defined *Eriocaulon septangulare* sommunities, in which *Lobelia dortmanna* is missing This is illustrated in the releves of columns V-VII of the table published in 1969 The association is based on 25 releves More than twice that number is given in the present study It appears from the present tables that *Eriocaulon septangulare* usually is accompanied by *Lobelia dortmanna*, and that *Eriocaulon septangulare* reaches the highest presence degree and combined estimation in the Isoeto-Lobelietum Therefore the Eriocauletum cannot be considered a good association any more

Communities with *Isoetes lacustris* and *I setacea* were not mentioned in the study of 1969 They are considered subassociations of the Isoeto-Lobe lietum in the present study They should have to be classified as variants of the Eriocauletum septangularis lobelietosum in the table of 1969

The *Subularia aquatica* communities were classified in the Eriocauletum into two units of different rank in the *Apium inundatum* variant of the subassociation of *Lobelia dortmanna*, and in the subassociation of *Subularia aquatica* This is not a satisfactory solution In the present study all *Subularia aquatica* releves are unified into a subassociation of *Subularia aquatica*

It appears that the classification into the Isoeto-Lobelietum gives a table that is more homotonous than it is in the case of the Eriocauletum

The releves from columns V and VI in the table of 1969 are classified into the Eleocharetum multicaulis in the present study

The name Lobelietum dortmannae (Osvald 1923) Tuxen 1970 MS is used by DIERSSEN (1972) for the *Lobelia dortmanna* communities This name should not be used, however, since OSVALD (1923) used methods in distinguishing vegetation units that differ from those used by TUXEN and DIERSSEN (1972) OSVALD's (1923) associations are based on dominant species, he distinguishes a *Myriophyllum alterniflorum* association a *Juncus bulbosus* association, a *Ranunculus reptans* association, a *Littorella uniflora* association and a *Lobelia dortmanna* association Especially the second, fourth and fifth association are very similar to each other in the floristic respect

The concept of an association as used by TUXEN and DIERSSEN is not based on the dominance of a single species, but on the total floristic composition of the community

It is not clear why the usually applied name Isoeto Lobelietum is not used by DIERSSEN (1972) It is true that no *Isoetes* species occur in his releves, but that is not a sufficient reason to abandon this name *Isoetes lacustris* and *I setacea* are excellent character taxa of the Isoeto Lobelietum, but they are very rare, even rarer than *Lobelia dortmanna*

VANDEN BERGHEN (1964) distinguished a Scirpeto-Lobelietum (Gadeceau) Vanden Berghen, which was later called Isoeto boryanae-Lobelietum dortmannae VandenBerghen (VANDEN BERGHEN 1969a) The species *Thorella verticillata-inundata* and *Juncus heterophyllus* are considered differential taxa towards the Isoeto-Lobelietum and the Eriocauleto Lobelietum by

VANDEN BERGHEN (1969a); they are found only in the southern part of the Atlantic Domain. VANDEN BERGHEN (1969a) considers *Lobelia dortmanna, Chara fragifera* and *Isoetes boryana* the character taxa of the association.

The Isoeto boryanae-Lobelietum dortmannae can indeed be considered a vicariant association of the Isoeto-Lobelietum. The vicariant species are *Isoetes boryana* for the first association, and *I.lacustris* and *I.setacea* for the second association. It is the opinion of the present author, however, that the differences between both associations are in fact not worth to distinguish two associations, the more so since *Isoetes boryana* is extremely rare.

So we shall consider *Lobelia dortmanna, Isoetes lacustris, I.setacea* and *Subularia aquatica* conregional character taxa of the Isoëto-Lobelietum. *Eriocaulon septangulare, Isoëtes boryana* and perhaps some other species will be considered intraregional character taxa, which means that they are geographically differential taxa. The terms conregional and intraregional are derived from MEYER DREES (1951).

The community which occurs in the lakes of the eastern Pyrenees and which was named Isoeteto-Sparganietum Borderei by BRAUN–BLANQUET (1948) is similar to the Isoëto-Lobelietum in some respects, viz. in its ecology, and by the fact that *Subularia aquatica* and *Isoetes lacustris* are found in both associations. See V.7, where the Sphagno-Sparganietum angustifolii is treated. The presence of *Lobelia dortmanna* in the „Charetum fragiferae" was reported by CORILLION (1953). The community can be considered as belonging to the Isoeto-Lobelietum, since *Lobelia dortmanna* is present in all relevés, just as *Littorella uniflora, Juncus bulbosus* and *Myriophyllum alterniflorum.*

The Characeae is poorly represented in the present work, although *Nitella* sp. was found twice, with a high cover degree, in the subassociation of *Isoetes setacea* in table 1. In VANDEN BERGHEN (1969a) *Chara fragifera* is considered a character taxon of the Isoeto boryanae-Lobelietum.

DAMBSKA (1967) has published a synoptic table with a number of variants of the subassociation of *Lobelia dortmanna* of the Isoeto-Lobelietum. All taxa except one in that table, are found in Isoeto-Lobelietum in western Europe. The variants are named after *Luronium natans, Sparganium angustifolium, Eleocharis palustris, Juncus bulbosus* and *Nitella flexilis.* A variant of *Eleocharis multicaulis* is not to be expected in Poland, since the differential taxa do not occur that far east.

JONS (1934) has classified most of the aquatic vegetation of the „Bultsee" in Sleswick-Holstein, northern Germany, into the Isoetetum echinospori Koch '26 *Isoetes setacea* is absent, but *Lobelia dortmanna* and *Isoetes lacustris* are found JONS (1934) however only considers *Littorella uniflora* a character taxon of the association, probably after KOCH (1926) Some of the subassociations that are distinguished by JONS (1934) are also encountered in the present study In the „*Littorella-Lobelia* reich Isoetetum" the species *Littorella uniflora, Lobelia dortmanna* and *Isoetes lacustris* reach the same cover degree, and this subassociation is therefore comparable to the subassociation of *Isoetes lacustris* in the present work The „*Myriophyllum* reich Isoetetum" is similar to the subassociation of *Myriophyllum alterniflorum* in the present work, whreas the „*Lobelia* reich Isoetetum" is comparable to the impoverished subassociation in the present work

PIETSCH (1965a) classified five associations into the Lobelio-Isoetion, a new alliance that was distinquished by him The associations are the Isoeto-Lobelietum Tx '37, the Eriocauleto-Lobelietum Br Bl et Tx '52, the Isoetetum tenellae Koch '26 (= I setaceae), the Myriophyllo-Littorelletum Jeschke '59 and the Charo-Lobelietum, a new association The fourth association does not contain *Lobelia dortmanna*

In PIETSCH (1971, MS) the second and the third association were not mentioned any more, but a new association was added the Junco (bulbosi)-Lobelietum ass prov PIETSCH (1971) only published the name of the association Its floristic composition and synecology remain unknown The name of the association does not provide information, because *Juncus bulbosus* is usually found when *Lobelia dortmanna* is present, at least in western Europe

In Scotland *Lobelia dortmanna* communities have been described by SPENCE (1964) His methods differ from the methods of the Zurich-Montpellier School, SPENCE bases the communities primarily on dominant species, whereas the differential and/or constant species are of secondary importance The total floristic composition is not taken into account Therefore the coena that are obtained by the different methods, are not directly comparable

Lobelia dortmanna is a dominant species in three sociations of the „*Juncus fluitans-Lobelia dortmanna* association" (SPENCE 1964) „the open *Littorella Lobelia* sociation, the *Lobelia-Littorella* sociation and the *Littorella-Juncus fluitans* sociation" The three sociations do not differ strongly in their floristic composition, but their dominants are different In the open *Littorella-Lobelia* sociation *Littorella uniflora* and *Lobelia dortmanna* are dominant, whereas *Eleocharis palustris* and *Juncus bulbosus* are constant species Total vegetation cover does not exceed 30%, the mean water depth is 29 cm and the soil is sandy

The two remaining sociations have the same mean water depth (50 cm) and the same soil, in most cases sand, in some cases brown mud *Lobelia dortmanna* is dominant in the *Lobelia-Littorella* sociation, and *Littorella uniflora* is dominant in the *Littorella-Juncus* sociation Total vegetation cover in these sociations lies between 53 and 60%, almost twice the cover of the open *Littorella-Lobelia* sociation

All three sociations in SPENCE (1964) are comparable with the impoverished subassociation of the Isoeto-Lobelietum of the present work, in this subassociation *Lobelia dortmanna Littorella uniflora* and *Juncus bulbosus* are the most important species *Lobelia dortmanna* is not dominant any more in the two remaining sociations of the *Juncus fluitans-Lobelia dortmanna* association of SPENCE (1964), viz the *Juncus-Utricularia (vulgaris)* sociation and the *Juncus-Sphagnum* sociation Both sociations are found on a brown mud containing a high percentage of organic matter This is not a favourable substrate for species such as *Lobelia dortmanna, Littorella uniflora* and *Isoetes lacustris* (WOODHEAD 1951) A thick layer of *Sphagnum* sp is not beneficial to the growth of isoetid species either, as has been explained earlier

The *Juncus-Sphagnum* sociation in SPENCE (1964) is similar to the subassociation of *Sphagnum* sp of the present study, although *Ranunculus flammula*, a constant species in SPENCE's table, is not found in the present releves *Drepanocladus fluitans, Sphagnum cuspidatum* and *Cladopodiella fluitans* on the other hand are constant species in the present work, but they are lacking in SPENCE's table

Lobelia dortmanna was found also in other communities by SPENCE in the *Nymphaea alba* ssp *alba* society, in the *Nuphar luteum* society and in the *Potamogeton natans* society, all belonging to the „floating leaved communities", which are mainly composed of nymphaeid taxa Since the *Nymphaea alba* society and the *Potamogeton natans* society (and to a lesser extent the *Nuphar luteum* society) are found in poor to rich water, and on sandy to organic soils, we may suppose that in these societies *Lobelia dortmanna* and *Littorella uniflora* are found mostly in poor water on sandy soils Here they have the best chances to survive

Lobelia dortmanna and *Littorella uniflora* have also been observed in some helophyte communities by SPENCE (1964) in the *Scirpus lacustris Juncus bulbosus* sociation, the *Equisetum fluviatile-Littorella* sociation, the *Eleocharis palustris-Littorella* sociation, the open *Carex rostrata* sociation and the

Phragmites-Sparganium (minimum) sociation. The mean vegetation cover does not exceed 50 %, the water is poor to moderately rich, and the soil is sandy in many stands.

SPENCE (1964) also described an *Isoëtes lacustris* society, found on sand or clay soils in 3-250 cm of water. *Juncus bulbosus, Littorella uniflora* and *Lobelia dortmanna* are frequent in this society, which is similar to the present tables of the subassociation of *Isoëtes lacustris* of the Isoëto-Lobelietum. SPENCE (1964) dit not mention stands that are dominated by *Isoëtes setacea,* although the species is found in Scotland. Communities that are dominated by *Isoëtes lacustris* are known from the English Lake District from PEARSALL (1920). The species was dominant in the „*Isoëtes lacustris* consocies", which was found in deep water, on stones or boulder clay. *Lobelia dortmanna* was not mentioned in the „deep water communities", but the species appeared to be important in some „shallow water communities", found mainly on a sand substrate. *Isoëtes setacea* and *Subularia aquatica* are not mentioned by PEARSALL (1920).

In THUNMARK (1931) the vegetation of Lake Fiolen in Sweden is described in detail. The syntaxa are based on dominant species; almost every aquatic species has its own consocion, often with some variants. This leads to syntaxa such as „*Littorella uniflora* reich *Lobelia dortmanna*" socion and „*Lobelia dortmanna* reich *Littorella uniflora*" socion; „*Ranunculus reptans* reich *Lobelia dortmanna*" socion and „*Lobelia dortmanna* reich *Ranunculus reptans*" socion.

Apart from the high cover degree of the character taxa, many of THUNMARK's socions can be recognized in the present tables, especially the socions that consist of several strata.

Some remarks have to be made concerning the subassociation of *Eleocharis multicaulis* of the Isoëto-Lobelietum. The relevés in the various tables show that this vegetation is more or less intermediate between the Isoëto-Lobelietum and the Eleocharetum multicaulis. How it can be decided into which association the intermediate vegetation should be classified?

Several authors have tried to solve such problems by calculating the „group value" of each association in the relevé. It is then classified into that association which provides the greatest share of the group value.

See for the various techniques SCHWICKERATH (1931), TÜXEN & ELLENBERG (1937), WESTHOFF & MÖRZER–BRUYNS (1956) and BECKING (1957).

When these techniques are applied to the present vegetation, no satisfactory results are got. This is due to the fact that the relevés are poor in species, and to the fact that floristic composition and combined estimation can fluctuate strongly

Since calculations do not give good results concerning this type of vegetation, one can best consider it an intermediate between two associations

Whether one wants to classify the releves into one or the other association or to keep them as a separate group, is a matter of personal decision

V.2 Eleocharetum multicaulis*) Allorge 1922 em. Tüxen 1937

V.2.1 Introduction

In this chapter communities are treated which are characterized by one or more of the following species *Deschampsia setacea, Eleocharis multicaulis, Echinodorus repens, Hypericum elodes, Potamogeton polygonifolius, Ranunculus ololeucos* and *Scirpus fluitans*

They have been described by ALLORGE (1922) for the first time, as two associations the „association à *Scirpus fluitans* et *Potamogeton polygonifolius*" and the „association à *Eleocharis multicaulis* et *Carex rostrata*" After ALLORGE both associations are typical for water which is poor in nutrients and which has a strongly fluctuating water level the former association is best developed in pools with more than 1 m of water and with steep slopes, whereas the latter is best developed in shallow water on gentle slopes The associations have been named after the species that were considered most characteristic by ALLORGE (1922)

SCHWICKERATH (1933) and CHRISTIANSEN (1935) have mentioned the same associations as ALLORGE (1922), SCHWICKERATH classified the association of *Scirpus fluitans* and *Potamogeton polygonifolius* into the Potamion eurosibiricum, and the association of *Eleocharis multicaulis* and *Carex rostrata* into the Phragmition communis CHRISTIANSEN (1935) followed SCHWICKERATH in this respect VLIEGER (1937) considered the latter association the terminal stage in the succession, forming part of the association of *Scirpus fluitans* and *Potamogeton polygonifolius*, this association was classified into the Littorellion

LEMEE (1937) described two associations, that correspond partly with ALLORGE's (1922) association of *Scirpus fluitans* and *Potamogeton poly-*

* The older name Eleocharetum multicaulis is applied instead of the version Eleocharitetum multicaulis, which is more recently proposed by RAUSCHERT (1963), and which is taken over by WESTHOFF & DEN HELD (1969) and others

gonifolius by the lack of *Potamogeton polygonifolius* and mosses; the Helodeto-Sphagnetum differs from ALLORGE's association of *Eleocharis multicaulis* and *Carex rostrata* mainly by the presence of *Potamogeton polygonifolius* and mosses

TUXEN (1937) distinguished only one association, viz. the Eleocharetum multicaulis, within the Littorellion. The association contains two subassociations, the subassociation of *Potamogeton polygonifolius* occurring in pools with a „strongly fluctuating water level," and the subassociation of *Agrostis canina* var. *stolonifera* in pools with a „fluctuating water level".

The Eleocharetum multicaulis sensu TUXEN (1937) has been mentioned by BENNEMA et al. (1943), PFEIFFER (1945), WESTHOFF et al. (1945), LEBRUN et al. (1949), OBERDORFER (1957), PASSARGE (1955, 1964), PIETSCH (1963, 1965a), WESTHOFF & DEN HELD (1969), SCHOOF–VAN PELT & WESTHOFF (1969) and DIERSSEN (1972).

CHOUARD (1925) noted a community which bears a great resemblance with the Eleocharetum multicaulis sensu TUXEN (1937): the „facies of *Potamogeton polygonifolius* and *Utricularia minor* of the association of *Potamogeton polygonifolius* and *Rhynchospora alba*".

In their study of the vegetation of Ireland, BRAUN–BLANQUET & TUXEN (1952) have split of a *Potamogeton polygonifolius- Hypericum elodes* association from the Eleocharetum multicaulis, and they classified the former association into the Helodo-Sparganion. The association resembles LEMÉE's (1937) Helodeto-Sphagnetum, although it differs from the latter association by the absence of *Eleocharis multicaulis.* TUXEN & OBERDORFER (1958), MULLER & GORS (1960) and OBERDORFER et al. (1967) have accepted the *Potamogeton polygonifolius-Hypericum elodes*-association, in the sense of BRAUN–BLANQUET & TUXEN (1952). The „association à *Potamogeton polygonifolius* et *Hypericum elodes*", mentioned by VANDEN BERGHEN (1958), is different from the association described by BRAUN–BLANQUET & TUXEN (1952) by the presence of *Eleocharis multicaulis.*

VISSER & ZOER (1972), in their study of the aquatic vegetation of western Ireland, have unified the two associations that were split up by BRAUN–BLANQUET & TUXEN (1952). VISSER & ZOER classified the relevés both with and without *Eleocharis multicaulis* into the Potameto-Hypericetum elodis. They did not classify the association into the Littorelletea - as is usually done - but into the Potamion graminei, an alliance of the order Luronio-Potametalia, class Potametea.

DEN HARTOG & SEGAL (1964) have rejected the position of the

Eleocharetum multicaulis within the Littorelletea, because of the different life forms and ecology of the species They classified the taxa, that are commonly regarded as character taxa of the Eleocharetum multicaulis, into the Hypericion elodis The authors consider it an alliance of disturbance-communities, the oligotrophilic counterpart of the Agropyro-Rumicion crispi SEGAL (1965) accepts the Eleocharetum multicaulis with *Eleocharis multicaulis* as character taxon, the species *Hypericum elodes, Scirpus fluitans* and *Deschampsia setacea* are regarded character taxa of the Hypericion elodis. SEGAL (1968) rejects the Eleocharetum multicaulis again, and he classifies „species such as *Eleocharis multicaulis, Hypericum elodes* and *Deschampsia setacea*" into a new alliance, the Juncion bulbosi.

TUXEN (1955) and RUNGE (1966, 1969) have distinguished an Eleocharetum multicaulis and a Scirpetum fluitantis, the latter being a community in which *Scirpus fluitans* is the dominant species

VANDEN BERGHEN (1969a) mentioned the Eleocharetum multicaulis Allorge, the Scirpeto americanae-Hypericetum elodis ass. nov. and the Scirpetum fluitantis Lemee, these associations are closely related, but they are classified into two alliances the first association into the Eleocharition multicaulis, and the remaining associations into the Helodo-Sparganion

In PIETSCH (1971) the name Littorello-Eleocharetum multicaulis Allorge 1922 was used, although ALLORGE (1922) did not mention this name, and although *Littorella uniflora* does not occur in ALLORGE's species list Moreover PIETSCH (1971) distinguished a new association, the Junco (bulbosi)-Eleocharetum multicaulis, as a nomen nudum, within the Juncion bulbosi BRAUN-BLANQUET (1967) has distinguished in the Pays Basque, in northern Spain, a *Hypericum elodes-Scirpus fluitans*-association, related to the Eleocharetum multicaulis, but classified by BRAUN-BLANQUET (1967) into the Anagallido-Juncion, a new alliance, within the order Anagallido-Juncetalia, class Molinio-Juncetea

Many phytosociologists have classified the Eleocharetum multicaulis into the Littorellion, viz TUXEN (1937), BENNEMA et al (1943), WESTHOFF et al (1946), PASSARGE (1964), PIETSCH (1963), SEGAL (1965), WESTHOFF & DEN HELD (1969) and SCHOOF-VAN PELT & WESTHOFF (1969)

Other phytosociologists have distinguished a second association besides the Eleocharetum multicaulis, this latter association was always classified into the Littorellion, and the former as follows BRAUN-BLANQUET & TUXEN (1952) and TUXEN & OBERDORFER (1958) classified the *Potamogeton polygonifolius-Hypericum elodes* association into the Helodo-Sparganion, MULLER & GORS (1960) classified the same association into the

Hypericion elodis, RUNGE (1966, 1969) classified the Scirpetum fluitantis into the Helodo-Sparganion

The Eleocharetum multicaulis was considered an association of the Helodo-Sparganion by LEBRUN et al (1949) and by OBERDORFER (1957), of the Eleocharition acicularis by PIETSCH (1965), and of the Hydrocotylo-Baldellion by DIERSSEN (1972) TUXEN (1955) classified both the Eleocharetum multicaulis and the Scirpetum fluitantis into the Helodo-Sparganion

V 2 2 The present relevés (tables 7 10 12-14)

The following subdivision is proposed within the Eleocharetum multicaulis

I subassociation of *Potamogeton polygonifolius*, Eleocharetum multicaulis potametosum polygonifolii
- a variant of *Scirpus fluitans*
  - 1 subvariant of *Apium inundatum*
  - 2 typical subvariant
- b typical variant
  - 1 typical subvariant
  - 2 subvariant of *Carex lasiocarpa*

II subassociation of *Littorella uniflora*, Eleocharetum multicaulis littorelletosum uniflorae
- a variant of *Scirpus fluitans*
  - 1 subvariant of *Deschampsia setacea*
  - 2 typical subvariant
- b typical variant
  - 1 subvariant of *Deschampsia setacea*
  - 2 typical subvariant

III impoverished subassociation, Eleocharetum multicaulis inops
- a variant of *Scirpus fluitans*
- b impoverished variant

IV fragments of Eleocharetum multicaulis
- a facies of *Scirpus fluitans*
- b facies of *Hypericum elodes*

The Netherlands

Relevés made by W. Diemont and G. Sissingh in 1939-1943.
Table 7

The following phytosociological units are represented: Ia1, Ia2, IIa1, IIa2, IIb1 and IIIa.

I subassociation of *Potamogeton polygonifolius* (relevés 1-10)
This subassociation differs from the following subassociations by the presence of *Potamogeton polygonifolius*. The impression is got that in the stands of this subassociation the water is deeper than in the next subassociation, where descriptions such as „humid depression" and „shallow water" are given in the legend; the data about water depth and soil properties are vague in many cases, however. The soil in this subassociation was muddy and/or organic in most cases; a sandy soil was mentioned only in the stand of rel. 8.

Ia1 variant of *Scirpus fluitans*, subvariant of *Apium inundatum* (relevés 1-4)
This subvariant differs in the floristic respect from the next subvariant only by the presence of *Apium inundatum*; there are no obivious ecological differences between the two subvariants. Besides, the name-giving species of this subvariant occurs with a higher abundance in subvariant IIa1 (subassociation of *Littorella uniflora*, variant of *Scirpus fluitans*, subvariant of *Deschampsia setacea*). In the French relevés, on the other hand, *Apium inundatum* is found in subvariant Ia1 only, with *Luronium natans* and/or *Myriophyllum alterniflorum*; in France, the subvariants are ecologically well defined as shall be seen later.

Ia2 variant of *Scirpus fluitans*, typical subvariant (relevés 5-10)
It is likely that the *Echinodorus* species in rel. 6 is *E. repens* *). KERN & REICHGELT (1950) mentioned records of *Echinodorus repens* in the moorland pool where rel. 6 has been made; *E.*

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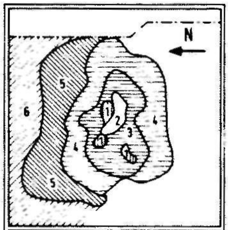
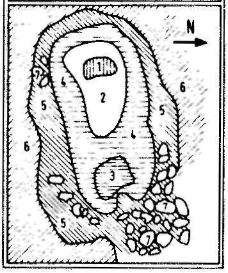
*) G Sissingh and W Diemont did not distinguish *Echinodorus repens* from *E ranunculoides*, but they considered all *Echinodorus* species as belonging to *E ranunculoides* In the region studied by W Diemont (Drenthe and Overijssel) only *E ranunculoides* occurs, but in North-Brabant, visited by G Sissingh, both species occur



1 rel. 1 from table 7
2 Nymphaea alba (deepest part)
3 vegetation of Carex vesicaria, Potentilla palustris, Glyceria fluitans etc
4 "Saliceto Betuletum" with much Myrica gale
5 "Ericetum" with Narthecium ossifragum
6 "Calluno-Genistetum molinietosum"



1 rel. 14 from table 19
2 vegetation of Eleocharis palustris, Echinodorus ranunculoides, Glyceria fluitans, Scirpus fluitans. Cover 5 %
3 rel. 17 from table 7
4 rel 9 from table 7
5 "Ericetum"
6 "Calluno-Genistetum molinietosum"
7 vegetation with Myrica gale, Betula sp.,Salix aurita, S cinerea

Fig. 4. *Vegetation of the Volther Veld at Weerselo, Overijssel. W.H. Diemont, 1939.*

Fig. 5. *Vegetation of the Ageler Veld at Denekamp, Overijssel. W.H. Diemont, 1939.*

ranunculoides was not observed there.

The contact vegetation of relevés 1 and 9 can be seen in the figs. 4 and 5 respectively. Fig. 4 shows clearly that the stand of rel. 1 must contain more than a few cm of water; it is situated close to the deepest part of the pool, where *Nymphaea alba* is a characteristic species.

II subassociation of *Littorella uniflora* (relevés 11-31)

Differential taxa are *Littorella uniflora, Deschampsia setacea* and *Carex serotina*. This subassociation is typical for the shallower parts of the moorland pools, and in many stands the soil runs dry in summer. In all but four relevés of this subassociation *Deschampsia setacea* occurs.

IIa1 variant of *Scirpus fluitans*, subvariant of *Deschampsia setacea* (relevés 11-16)

IIa2 variant of *Scirpus fluitans*, typical subvariant (relevés 17-20)

The floristic difference between the subvariants 1 and 2 (*Deschampsia setacea* present respectively absent) does not coincide with a conspicuous habitat difference; soil data are vague.

IIb1 typical variant, subvariant of *Deschampsia setacea* (relevés 21-31)

This subvariant with the differential taxa *Littorella uniflora* and *Deschampsia setacea* was found in many stands on a muddy soil At first sight this soil factor may be thought to be responsible for the lack of *Scirpus fluitans* This explanation is improbable, however, since *Littorella uniflora* and *Deschampsia setacea* are still present, these species are much more dependent on a sandy soil than is *Scirpus fluitans*

Rel 29 has great historical value, as it is probably the only Dutch releve with *Hypericum canadense* The ecology of this amphi-atlantic species is known vaguely from The Netherlands WESTHOFF (1971) observed the species in Ireland in a complex habitat of mini-, macro-, meso- and microgradients The releve made by W Diemont (rel 29) corresponds with the releves published by WESTHOFF (1971) by the great number of Littorelletea character taxa and by the presence of *Hydrocotyle vulgaris, Ranunculus flammula* and *Calliergonella cuspidata* The character taxa of Nanocyperion, Caricion curto-nigrae, Caricion davallianae, Juncion acutiflorae, Molinietalia, Molinio Arrhenatheretea, Phragmitetea and Agropyro-Rumicion crispi, present in WESTHOFF's releves, are absent in rel 29

III impoverished subassociation (relevés 32-35)

IIIa variant of *Scirpus fluitans* (releves 32-35)

This variant is characterized by the combination of *Eleocharis multicaulis, Hypericum elodes* and *Scirpus fluitans* Although it is difficult to characterize the habitat of a group of only four releves, especially when data about the habitat are vague, the descriptions indicate a meso-eutrophic or disturbed habitat

Releves made by the S O L investigators in 1957 1959

Table 8

The following phytosociological units are represented Ib2, IIb1, (IIb2), IIIa, IIIb, IVa and IVb

I subassociation of *Potamogeton polygonifolius* (releves 1-10)

Ib2 typical variant, subvariant of *Carex lasiocarpa* (releves 1-10)

Differential taxa of this subvariant are *Potamogeton polygoni-*

folius and *Carex lasiocarpa* The releves are derived from three different pools, two of which are situated close by each other, and all in the Kempen district It is striking that no such relevés from the other parts of The Netherlands occur in this group, as both differential taxa are found in the north and east of the country as well In the stands of releves 5, 6, 8 and 9 the water was rather deep (15-60 cm), whereas in releves 2, 3 and 7 the water level is equal to or below the surface In that case a thick, waterlogged peat cushion is present below the vegetation All releves had a soil with a top layer of organic matter of at least 5 cm thickness There are few companions, and ecotone species are almost absent, in contrast to the other subassociations

II subassociation of *Littorella uniflora* (releves 11-21)

IIb1 typical variant, subvariant of *Deschampsia setacea* (releves 11-20)
In most releves *Littorella uniflora* is missing, but the subassociation is sufficiently characterized by its differential taxon *Deschampsia setacea* The water depth is not as extreme as in some stands of the former subassociation, 35 cm is the greatest depth found here A number of stands runs dry in summer The substrate is sandy, and the sand may be covered by a thin layer of organic matter, not more than 5 cm thick Only rel 16 forms an exception, with an organic top layer of 30 cm
Frequent companions in this subvariant are *Hydrocotyle vulgaris* and *Molinia caerulea*

IIb2 typical variant typical subvariant (rel 21)
There is only one representative of this subvariant, of which *Littorella uniflora* is the differential taxon The soil of the stand consisted of organic matter on sand, and all the companions were mosses

III impoverished subassociation (releves 22-86)

IIIa variant of *Scirpus fluitans* (releves 22-30)
The variant which is characterized by *Scirpus fluitans*, contains *Littorella uniflora* in some releves the latter species never reaches a high cover degree The variant is found usually in water that is deeper than 15 cm, the soil consists of sand, or sand covered with a thin of thick layer of organic matter The weak top layer is usually thicker than in the former subassociation

IIIb impoverished variant (releves 31-86)

In five relevés two or three character taxa of the association are present, but in the majority of the releves it is only *Eleocharis multicaulis* Other frequent species in this variant are *Juncus bulbosus, Molinia caerulea, Eriophorum angustifolium, Hydrocotyle vulgaris* and *Sphagnum cuspidatum*

All of them, exept *Hydrocotyle vulgaris,* indicate a poor, acid habitat In some releves the less oligotrophilic *Sphagnum crassicladum* s l is the dominant moss instead of the very oligotrophilic *Sphagnum cuspidatum,* especially in the relevés where *Eleocharis multicaulis* and *Hypericum elodes* occur together

IV facies of *Scirpus fluitans* and of *Hypericum elodes* (relevés 87-101)

In II 1 the limes convergens habitat has come up already It was mentioned there that the plant communities, characteristic of such habitats, are poor in species and rich in individuals

The species *Scirpus fluitans* and *Hypericum elodes* probably also belong to the group of taxa which need a dynamic habitat It was frequently observed that both species could form extended, almost monospecific stands (facies) in certain circumstances Therefore, these facies are treated separately

IVa facies of *Scirpus fluitans* (releves 87-90)

In all stands of this group eutrophication may be held responsible for the disturbance in the pools, causing a facies of *Scirpus fluitans* In the pool of rel 87 the eutrophication was not specified, but it is probably caused by agriculture, as in the stands of relevés 89 and 90 A rubbish-heap in the close vicinity of the pool where rel 88 was made, has caused a strong eutrophication

IVb facies of *Hypericum elodes* (releves 91-101)

Disturbance in the form of eutrophic influences was present in the stands of releves 91, 92, 93, 94 and 97 The pools of relevés 96 and 98 were cleaned completely and partly respectively in 1950, and the S O L investigator Mr P Glas remarked that „no stable situation was reached in 1957" It seems that there was no stable situation in 1959 either (when releves 96,98 and 99 were made), for which the busy recreation activities may be partly held responsible

A very steep shoreline - a sharp borderline - probably caused the

large *Hypericum elodes* vegetation in releves 100 and 101
In the case of rel 95 no disturbance was observed, eutrophication was apparently not present, and there was no steep shoreline either

Relevés made by the present author in 1968-1971
Table 9

The releves can be classified into the following phytosociological units Ia2, IIb1, IIb2, IIIa, IIIb, IVa and IVb

I subassociation of *Potamogeton polygonifolius*

Ia2 variant of *Scirpus fluitans*, typical subvariant (rel 1)

Only one releve represents this subassociation, variant and subvariant The vegetation was found on the bottom of a ditch in a moorland, running dry in summer On the day of the visit a part of the shriveled vegetation covered the sandy soil as a crest, thus protecting the soil against drying out No eutrophic water ever
(2) comes into this ditch Since this was the only releve belonging to this subassociation found during my research period, this specific vegetation does not seem to occur frequently (any more) The fact that the differential taxon of this subassociation, *Potamogeton polygonifolius,* is rare in the Littorelletalia-communities nowadays implies that the characteristic habitat is rare (VAN LEEUWEN 1967) The impression is got from the preceding tables, that *Potamogeton polygonifolius* and the subassociation characterized by this species prefer rather undisturbed habitats rarely found at present In the Dutch tables belonging to this subassociation the ecotone species play a relatively unimportant role in comparison to the other subassociations This phenomenon can partly be attributed to the greater waterdepth, but the undisturbed habitat also plays a part *Potamogeton polygonifolius* now occurs mainly in undisturbed, but much more oligotrophic habitats than Littorelletalia habitats usually are See also Chapter VI

II subassociation of *Littorella uniflora* (releves 2-20)

IIb1 typical variant subvariant of *Deschampsia setacea* (releves 2-9)

The differential taxon of the subvariant, *Deschampsia setacea*, is found in all eight relevés, the differential taxon of the subassociation, *Littorella uniflora*, in five of them. The soil is solid, consisting of pure sand, or sand covered or mixed with organic matter. Most stands run dry in summer, but some stay inundated the whole year through.

Two measurements of the water are derived from the sample plots itself; they show a circumneutral and a strongly acid water respectively. The amounts of Cl^-, Na^+ and Ca^{2+} are rather high in the stand of rel. 3, viz. 27, 23 and 47 mg/l respectively. Ecotone species *Hydrocotyle vulgaris* or *Agrostis canina* are present in all relevés, and *Molinia caerulea* and *Ranunculus flammula* occur in half of the relevés.

IIb2 typical subvariant (relevés 10-20).

Deschampsia setacea is missing in these relevés, but the differential taxon of the subassociation, *Littorella uniflora*, is more frequent and has a higher combined estimation than in the previous subvariant. The ecotone species are represented by either *Agrostis canina* or *Hydrocotyle vulgaris*, whereas *Molinia caerulea* and *Ranunculus flammula* are almost lacking. The sandy subsoil is usually covered with mud or organic matter up to 10 cm thickness. Some stands run dry in summer, some keep a shallow layer of water. The pH-measurements, derived from the sample plots itself, show strongly (to moderately) acid water, and an electrical conductivity of about 100 μS. The differences between the two subvariants, however, are just as large as those within the subvariants themselves; the relevés of both subvariants containing *Sphagnum* spec. show a distinctly lower pH than the relevés in which this genus is missing.

III impoverished subassociation (relevés 21-52).

IIIa variant of *Scirpus fluitans* (relevés 21-29).

This is the only variant in this table in which *Scirpus fluitans* is present; *Hypericum elodes* is much more frequent than *Eleocharis multicaulis*. The combination of *Hypericum elodes* and *Scirpus fluitans*, when found in Ireland, indicates a habitat that is more or less enriched in nutrients, usually by means of the wind that supplies salts from the sea. But as for the Dutch table the water analyses did not reveal high values for pH, electrical conductivity, or Cl^-, Na^+ or Ca^{2+} The water appeared to be acid, with an electrical conductivity of about 100 µS Two stands, situated close to each other, showed a high value for K^+ (20 mg/l), which may be due to the use of artificial fertilizers in the neighbour hood

All pools give the impression that they are more or less metatrophic due to a recent disturbance or a disturbance that is still present This disturbance consists of the supply of nutrients The habitat of this variant seems to be richer in nutrients than the habitat of the following variant, which can be concluded from the fact that the oligotrophilic species *Eriophorum angustifolium, Sphagnum orassicladum* and *S cuspidatum* are not or badly represented, whereas the eutrophilic species *Potamogeton natans* and the ecotone species *Agrostis canina* have a higher presence degree in this variant Moreover, the water analyses give higher values for every factor measured, except perhaps for the electrical conductivity All kinds of substrates were found sand, loamy sand, and sand covered with a thin or thick layer of organic matter or mud, the soil was usually weaker than in the subassociation of *Littorella uniflora*

IIIb impoverished variant (releves 30-52)

This is a very impoverished variant, *Eleocharis multicaulis* being the only character taxon of the Eleocharetum multicaulis that is present The variant is characterized by the combination of *Eleocharis multicaulis, Juncus bulbosus, Sphagnum cuspidatum* and *S crassicladum*, and to a lesser extent by *Eriophorum angustifolium* and *Molinia caerulea* This variant was found in a great variety of water depths - below surface till 50 cm deep - but in all cases the water was very acid (pH 3 6-4 6) Electrical conductivity was usually about 100 µS, but exceptions in both directions occurred, 46 µS being the lowest and 200 µS being the highest measured value

The soil always has a top layer of organic matter Rel 52 is the only releve in which *Sphagnum* sp are lacking, this pool does not belong to the oligotrophic type from which the other releves are derived The deep water on the spot and the relative richness in nutrients (due to a farmhouse in its immediate surrounding) can be seen as the factors together prohibiting the growth of species such as *Juncus bulbosus, Hypericum elodes* and *Sphagnum* species On parts of the shore however, acid water leaching from the soil of a pine-forest reaches the pool and the water is shallow, the above mentioned species occur there Rel 17 gives an impression of such a site

IV facies of *Scirpus fluitans* and facies of *Hypericum elodes* (relevés 53-60)

IVa facies of *Scirpus fluitans* (relevés 53-56)

Relevés 53 and 55 are derived from a pond, which is heavily polluted due to rubbish-heap close to the shore, besides the pond is visited by many people who trample down the shore Both pH and electrical conductivity are rather high (7 5 and 244 μS respectively), and so is the NO_2^- content (0 024 mg/l), the sandy soil was covered with a few cm of mud

The disturbing factor in releves 54 and 56 is not clearly detectable, although *Typha angustifolia*, growing in the pools, is an indicator of a eutrophic habitat, this is not seen in the electrical conductivity of the water (133 and 66 μS respectively)

IVb facies of *Hypericum elodes* (releves 53-56)

The pool of rel 54 harboured already in 1957 a facies of *Hypericum elodes*, as appears from the investigations made by the S O L (Rel 94 in table 8) A eutrophicating influence from a ditch, draining meadows, was reported in 1957 by E van der Voo The situation in the pool deteriorated then, the water surface, about 10 000 m^2 in 1957, had decreased to only a few m^2 in 1970, thus draining most of the substrate of the water plants This draining did not seem to be due to the normal seasonal fluctuation, as it was too extensive

But for *Hypericum elodes* this was not (yet) disastrous *Littorella uniflora*, however, has disappeared after 1957, and *Sphagnum crassicladum* has almost disappeared In the remaining releves a steep slope plus some eutrophication probably caused the ecotone

N B *Sphagnum majus* (= *S dusenii*) was discovered in a new locality, the „Ossenkolk" at Ermelo in the province of Guelderland It was known from the „Mosterdveen" in the same municipality (BARKMAN & GLAS, 1959) The species has been identified by G J Baayens from Wijster

France (table 10)

The following phytosociological units are represented in the table Ia1, Ia2, IIb2, IIIa, IIIb, IVa and IVb

I subassociation of *Potamogeton polygonifolius* (releves 1-18)

Ia1 variant of *Scirpus fluitans*, subvariant of *Apium inundatum* (releves 1-8)

This subvariant is characterized by *Potamogeton polygonifolius* and *Scirpus fluitans*, and by *Apium inundatum, Myriophyllum alterniflorum* and *Luronium natans* The latter three species have their optimal habitat in pools which run dry only shortly and occasionally, usually in deeper water than the Eleocharetum multicaulis Therefore one should expect this subvariant to represent the deepest growing community of the Eleocharetum multicaulis As a matter of fact, the measured water depths of (10) 20-40 cm appear to be all but one rather deep for this association, and they are much greater than in the next subvariant, whre the depth usually is between 0 and 10 cm The character taxa of the Potametea, that are well represented in this subvariant also indicate rather deep and moreover permanent water, not or only rarely and shortly running dry The proportion of ecotone species is greater in the next subvariant than in this subvariant The pH was found to be slightly (6 2-6 4) to strongly (4 5) acid, and the electrical conductivity gave values between 88 and 313 μS

The substrate is weak, consisting of sand, covered with organic matter or mud

In tabel 11 four releves show a vegetation with *Apium inundatum, Myriophyllum alterniflorum* and *Luronium natans*, but almost devoid of character taxa of the Eleocharetum multicaulis The releves should have to be classified into the Luronio-Potametalia, according to DEN HARTOG & SEGAL (1964) and WESTHOFF & DEN HELD (1969)

Table 11

nr	1	2	3	4
cover %	90	100	100	80
waterdepth (cm)	30	0-10	40	0-20
number of taxa	11	12	3	7
character taxon of Eleocharetum multicaulis				
Hypericum elodes	1 2			
character taxon of Eleocharition acicularis				
Echinodorus ranunculoides				2a 3
indicators of deeper water				
Apium inundatum	2m 2	3 3	1 1	+ 1
Myriophyllum alterniflorum	1 2	1 2		2b 2
Luronium natans	3 2		5 5	1 2
character taxa of Phragmitetea				
Eleocharis palustris ssp *palustris*	2m 2			2m.2
Glyceria fluitans	2b 2	2m 2		
Rorippa amphibia	1 2			
Oenanthe fistulosa		+ 1		
Equisetum fluviatile				+ 1
differentials of Agropyro-Rumicion crispi				
Agrostis stolonifera	1 2	2m 2		
Hydrocotyle vulgaris	+ 1			
Veronica scutellata		1 1		
Ranunculus repens		1 1		
character taxon of Potametea				
Ranunculus aquatilis s l	3 2	1 2		1 1
remaining species				
Galium palustre	+ 1	+ 1		
Cardamine pratensis		+ 1		
Ranunculus flammula		1 2		
seedling			1 1	
mosses				
Drepanocladus aduncus		3.3		
pH	7 7		6 7	9 6

rel 1 pool at Trébedan, Côtes-du-Nord, Brittany, weak soil

rel 2 pool at Wardrecques, Pas-de-Calais, close to a house, muddy soil

rel 3 pool a little north of étang de Fourneau, on the border between Côtes-du-Nord and Morbihan, Brittany, weak soil

rel 4 etang de Beaulieu, south west of Dinan, Côtes-du-Nord, Brittany People wash their clothes on this shore of the lake and they clean fertilizer bags Sandy soil covered with a thin layer of mud

The question arises why character taxa of the Eleocharetum multicaulis are so badly represented in these releves In the case of rel 2 the water depth cannot be held responsible, as it is not more than 10 cm Here the trophic level of the water may be a limiting factor, since the pool is situated in the immediate vicinity of a small farm It is visited frequently by domestic animals, and the inhabitants of the farm spill their waste water into the little pool The pools situated further away from the farm contain less eutrophicated water, and the species *Eleocharis multicaulis, Hypericum elodes, Potamogeton polygonifolius* and *Scirpus fluitans* are noted there (releves 8, 15 and 44 in table 10) The water depths of the sites were 20, 5-10 and 25 respectively People were seen to wash their clothes in the pool of rel 4, the soap caused an extreme reaction of the water (pH 9 6') The very alkaline water in combination with the steep slope make the absence of character taxa of the Eleocharetum multicaulis plausible Fig 6 shows the values of the pH at different distances from the wash-place

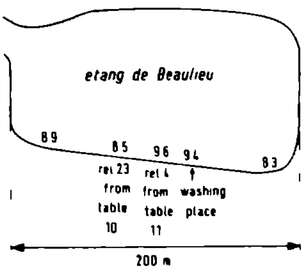


Fig 6 pH measurements from etang de Beaulieu, Brittany, France

The vegetation of rel 23 in table 10 seems to meet with less influence of the soap, since *Eleocharis multicaulis, Littorella uniflora* and *Juncus bulbosus* are present Rel 3 was made in a pool where the water is kept constantly on the same level, this is done on behalf of wildfowl preservation for the sake of hunting interest The constant depth of 40 cm in the sample plot is too great for many Littorelletea species to establish or, if they were previously there, to maintain themselves Rel 1 was made in the close vicinity of rel 20 in table 10, in the latter six character taxa of the Littorelletea are present, whereas only three are present in rel 1 of table 11 The question arises what may be the reason for the difference The trophic level will be about the same in both sites, it may even be more eutrophic in the site of rel 20 because this site is visited by cattle The animals were not seen in the site of rel 1 Contrary to rel 20 the surface of the water in the stand of rel 1 is almost completely covered with floating vegetation, this may be the factor excluding photophilous species that grow on the bottom and do not reach the surface of the water, such as *Littorella uniflora* and *Echinodorus ranunculoides*

Ia2 typical subvariant (relevés 9-18)

The majority of the releves 9-18, which are devoid of *Apium inundatum, Myriophyllum alterniflorum* and *Luronium natans*, is derived from water that is shallower than in the preceding subvariant, viz 0-10 (20) cm, the chance for the sites to run dry in summer is therefore considerable In most stands the soil is weak, consisting of sand usually covered with mud, although pure sand was found as well The water was moderately acid (pH 5-6), and the three measurements of the electrical conductivity gave values of 123, 127 and 154 μS The relevés 9 up to 12 inclusive are derived from sites with intermittently running water, the water depth did not exceed 10 cm In the remaining releves of this subvariant the water was deeper and stagnant

Taxa representing the Phragmitetea and the Agropyro-Rumicion crispi are well represented, and so are *Ranunculus flammula* and *Molinia caerulea*

II subassociation of *Littorella uniflora* (releves 19-26)

Differential taxa are *Littorella uniflora* and *Carex serotina*

IIb2 typical subvariant (relevés 19-26)

Most relevés (19, 21, 22, 24 and 26) are derived from the weather-sides of large lakes where the vegetation is exposed to the action of wind and waves, counteracting sedimentation Most soils were sandy, and in some cases the sand was covered with a thin layer of mud

Rel 20 is derived from a pool that is rather rich in nutrients, in contrast with rel 1 of table 11 the tender Littorelletea species get a chance to maintain themselves, because the cattle trample down the tall, eutrophilic species, by this way reducing their light competition with the Littorelletea species Rel 25 is derived from the same pool, but from a shallow site that was not visited by cattle In rel 1 of table 11 eutrophication caused by domestic animals and men is held responsible for the lack of Littorelletea species Releves 19 and 24 are taken from another rich pool, here cattle is said to have a positive influence on Littorelletea species Both statements seem contradictory The first mentioned pool, however is much smaller than the second one The first pool is situated close to a farmhouse, therefore eutrophication will be greater than in the latter pool This pool was not situated in the close vicinity of houses, and the visits of cattle may be less frequent On the day of the visit only their footprints were there The first pool is easier saturated with nutrients than the second one, because it is smaller and because more nutrients are supplied WESTHOFF (1969) mentions that eutrophicating influences of cattle can be neutralized by their glutton He illustrates this with an example from Lough Corrib in Ireland

Rel 23 was made in the pool that was described at table 11 (see also fig 6) This site was apparently less influenced by wash-water and moreover the shore was less steep, therefore it was fit better for Littorelletea phytocoenoses than the site of rel 4 was

The pH-measurements in this subvariant show alkaline water (pH 7 1 8 5), the electrical conductivity was not extremely high (141 and 166 μS)

III impoverished subassociation (releves 27-40)

IIIa variant of *Scirpus fluitans* (releves 27-36)

Although this variant is well defined floristically, the ecological differences between this variant and the subassociations I and II are not clear In some cases one releve from a pool is classified into subassociation I, whereas another releve from the same pool belongs to subassociation III, without any distinct ecological differences This is seen in the releves 18 and 27, respectively 19 and 30 The water was usually moderately acid (pH 5 5-6 6 and 4 5 once), the electrical conductivity reached values between 119 and 166 μS, and once 313 μS was measured The soils were varied sand, sand covered with a thin layer of mud, sand covered with a thick layer of organic matter and stones with mud

Ecotone species were present only in part of the releves

IIIb impoverished variant (releves 37-40)

These releves correspond with each other by the lack of *Potamogeton polygonifolius*, *Littorella uniflora* and *Scirpus fluitans*, but for the rest the floristic similarity is little The waterdepth reaches low and high values, and so does the number of companions Weak and solid soils were found

IV facies of *Scirpus fluitans* and of *Hypericum elodes* (releves 41-46)

IVa facies of *Scirpus fluitans* (releves 41-45)

The fact that *Scirpus fluitans* and *Hypericum elodes* may form facies as a response to ecotones is mentioned already at the Dutch releves of this association In the case of releves 42 and 43 the water is extremely deep for Eleocharetum multicaulis communities (85 and 60 cm), but it does not seem to hinder the development of *Scirpus fluitans* Rel 45 is derived from a heavily disturbed site in a large lake, the turbid water was smelling and it was coloured green by the luxurious growth of filamentous algae The pH in the site was 9 0, whereas it reached values between 6 5 and 7 3 in other parts of the lake

In the stands of releves 41 and 44 no clearly detectable ecotone was seen, the pools were not eutrophicated but the water may be too deep for *Eleocharis multicaulis*, which was present in less deep sites The pools were just filled up with *Scirpus fluitans* in the central part, where a depth of 60 cm was measured

IVb facies of *Hypericum elodes* (rel 46)

This facies may be conditioned by a rather steep slope in combination with a slight eutrophication

Scotland (table 12)

In this table the following phytosociological units can be distinguished Ib1, IIb1, IIb2 and IIIb

The Eleocharetum multicaulis is represented by only 7 releves, this is due to the fact that most of its character taxa do not occur or are very rare in the northern part of Scotland, the part that was visited by the present author

I subassociation of *Potamogeton polygonifolius* (releves 1-2)

Ib1 typical variant, typical subvariant (releves 1-2)

The two releves with *Potamogeton polygoniofolius* are derived from a pool that receives peaty water from the more elevated surrounding, the soil is muddy and contains a thick layer of organic matter The pH of the two stands is strikingly different, 8 1 and 6 1

Another difference exists in the species number 5 species in rel 1 and 15 in rel 2 In the second releve the cover percentage is much higher than in the first releve (60% and 5-10% respectively) Therefore the humus production is greater in the first site, this may be responsible for the lower pH

II subassociation of *Littorella uniflora* (releves 3-6)

IIb1 typical variant, subvariant of *Deschampsia setacea* (releves 3-4)

Both releves were made on humid shores of lakes, but the soils were very different the stand of rel 3 had a soil consisting of sand and gravel that was covered with a thin layer of mud, whereas in the stand of rel 4 there was a black muddy soil, that was very weak

IIb2 typical subvariant (releves 5-6)

The soils were about the same as in IIb1 a black mud in the stand of rel 5, and sand and gravel (without mud however) in the stand of rel 6 The releves are derived from the humid shores of a pool and a lake respectively

III impoverished subassociation (rel 7)

IIIb impoverished variant (rel 7)

Only one releve can be classified into this variant, but it is doubtful whether it can be assigned to the Eleocharetum multicaulis, since the association is only represented by *Eleocha* *ns multıcaulıs* wıth a combıned estımatıon of 3, whıle *Utnculana neglecta* has a combıned estımatıon of 4 and *Menyanthes tnfolıata* of 2a

The soıl ıs organıc and the top layer consısts of flocculent matenal The pH of 8 0 ıs rather hıgh

Ireland (table 13)

The followıng phytosocıologıcal unıts are represented Ia2, Ib1, II, IIIa and IIIb.

The name-gıvıng specıes of the assocıatıon, *Eleochans multıcaulıs*, ıs not restncted to the Eleocharetum multıcaulıs ın westem Ireland The specıes ıs found regularly ın blanket-bogs, where no rother character taxa of the assocıatıon are found (WESTHOFF, 1969a) A well developed Eleocharetum multıcaulıs ıs only found ın habıtats whıch are less olıgotrophıc than blanket-bogs, e g ın pools near the coast, ınto whıch lıme holdıng sand from the beach ıs blown along the shores of nvers and beaches, and ın pools whıch are slıghtly ennched by agncultural ınfluences

I subassocıatıon of *Potamogeton polygonıfolıus* (relevés 1-15)

Ia2 vanant of *Scırpus fluıtans*, typıcal subvanant (releves 1-7)

Thıs subvanant ıs charactenzed maınly by *Potamogeton polygonıfolıus* and *Scırpus fluıtans*, *Hypencum elodes* and *Eleochans multıcaulıs* are less frequent than the former specıes

Thıs subvanant was found usually on a muddy soıl, although ın two stands (rel 3 and 5) the substrate consısted of stones covered by a thın muddy layer In three stands a water depth between 10 and 30 cm was measured, ın other stands the water was at or below surface

Water analyses are scarce, they ındıcate a cırcumneutral water (pH 6 7 and 7 7) The only Na^+-measurement (rel 2) shows a rather hıgh value of 25 mg/l, whıch ıs caused by the posıtıon of the lake close to the sea The pools and lakes from all releves but rel 3 were sıtuated close to the sea, so all these stands are presumed to contaın water nch ın Na^+ (and Cl^-)

Enocaulon septangulare, Sparganıum mınımum, Juncus artıculatus, Mentha aquatıca, Agrostıs stolonıfera and *Hydrocotyle vulgans* are more frequent ın thıs subvanant than they are ın subvariant Ib1 *Molinia caerulea* *Sphagnum crassicladum* and *Scorpidium scorpioides* are far more frequent in subvariant Ib1 The presence of these meso- or eutrophilic species (only *Eriocaulon septangulare* is oligotrophilic), and the absence of the oligotrophilic species suggests that in this subvariant the habitat is richer in nutrients than in the next subvariant

Ib1 typical variant, typical subvariant (relevés 8-15)

Eleocharis multicaulis and *Hypericum elodes* are more frequent here than they are in Ia2 *Deschampsia setacea* was found twice in this variant

The soil and the water depth do not differ much from the same factors in Ia2 although the deepest water (100 cm) is found in this variant The pH was found to be lower (5 6) than in the preceding subvariant, but it concerns only one measurement

As all releves are derived from pools situated close to the sea, this will be reflected in the chemical composition of the water The floristic differences with the former subvariant have been mentioned already

II subassociation of *Littorella uniflora* (releves 16-18)

This subassociation is represented by only three releves, with *Eleocharis multicaulis*, *Juncus bulbosus*, and the differential taxa, *Littorella uniflora* and *Carex serotina* present in all of them Mosses are lacking and so are character taxa of Parvocaricetea and Phragmitetea Two releves are derived from the temporary dry, shore of a large lake, with muddy soil The remaining releve was made in a small lake in 20 30 cm water, where the vegetation was growing on stones covered with a thin layer of mud The pH was circumneutral (6 6)

By the low number of relevés of this subassociation and the divergent habitats, the subassociation is difficult to characterize ecologically

III impoverished subassociation (releves 19-28)

IIIa variant of *Scirpus fluitans* (releves 19-22)

The releves of this variant are characterized by *Scirpus fluitans*, this species presents a high cover degree in all relevés In the pool where the relevés 19 and 22 have been made a disturbed habitat was noted, bottles, tins and other rubbish had been thrown into the little pool *Hypericum elodes* and *Scirpus fluitans* can form facies in disturbed conditions, as is shown in tables 8, 9 and 10 already Relevés 19 and 22 represent such conditions, they are transitional to IVa (facies of *Scirpus fluitans*) and IVb (facies of *Hypericum elodes*) respectively

An organic substrate was found in the sample plots of the relevés 19, 20 and 22, whereas in the sample plot of rel 21 a layer of mud covered the underlaying rock

The water usually was between 5 and 30 cm deep

IIIb impoverished variant (releves 23-28)

This variant was noted on organic mud soils, in one stand the substrate consisted of stones covered with a thin layer of mud

The water level was usually just below or just above surface

The water analyses indicate moderately acid water (pH 5 2-6 7) with 22 and 30 mg Cl^{-}/l and very little Ca^{2+} (less than 2 mg/l)

Sphagnum section *Subsecunda* is usually present and so are *Hypericum elodes* and *Eriocaulon septangulare*

V.2.3 Synecology

The Eleocharetum multicaulis meets with the influence of the fluctuating water level far more than the Isoeto Lobelietum, the former association occurs on a higher part of the shore, and therefore the sites run dry some parts of the year This appears from the present tables, especially in the subassociation of *Littorella uniflora*

The periodical running dry of the stands of this association has been mentioned by BUKER (1939), MORZER–BRUYNS & PASSCHIER (1943), PFEIFFER (1945), ALTEHAGE (1957), MULLER-STOLL et al (1962), PIETSCH (1963), GÉHU (1964) and VANDEN BERGHEN (1964, 1967, 1969a)

The greatest depth in which the association is usually found, is less than 50 cm (LEMEE 1937, VANDEN BERGHEN 1969a), although PIETSCH (1963) mentioned a subassociation in 30-80 cm, and ALLORGE (1922) in more than 100 cm This is in accordance with the water depths mentioned in the present work In the table 8 a depth of 60 cm was measured three times, and in the Irish relevés a water depth of 100 cm was seen once

When in previous publications subassociations are distinguished within the Eleocharetum multicaulis, an important ecological difference is often the water depth, sometimes in combination with different substrates ALLORGE (1922), LEMEE (1937), BENNEMA et al (1943), PASSARGE (1955, 1964), PIETSCH (1963) and VANDEN BERGHEN (1969a) In some of these cases the subassociation of the deeper water contained *Potamogeton polygonifolius* (or *P natans*) ALLORGE (1922), BENNEMA et al (1943) and PIETSCH (1963), in the same way the subassociation of *Potamogeton polygonifolius* in the present study was found in the deepest water

Two different substrates are mentioned in previous publications, a peat and a sand one The Eleocharetum multicaulis with *Littorella uniflora* usually coincides with a sand substrate BUKER (1939), BENNEMA et al (1943), LEBRUN et al (1949), BRAUN BLANQUET & TUXEN (1952), MULLER–STOLL et al (1962), VANDEN BERGHEN (1969a) and SCHOOF–VAN PELT & WESTHOFF (1969) PIETSCH (1963) mentions the variant of *Littorella uniflora* in the Eleocharetum multicaulis to be found on sand, but substrate data of the other units of the association are lacking

According to PASSARGE (1955) both subassociations are found on sand In ALTEHAGE (1960) the occurrence of the Eleocharetum multicaulis with *Littorella uniflora* is mentioned for a sand substrate with a top layer of 1-2 cm of decaying plant material The pool which is mentioned by ALTEHAGE (1960) is in the process of eutrophication, however, so no equilibrium is reached

Littorella uniflora is usually absent on a peat substrate ALLORGE (1922), CHOUARD (1925), SCHWICKERATH (1933), LEMEE (1937), LEBRUN et al (1949), BRAUN–BLANQUET & TUXEN (1952), VANDEN BERGHEN (1968, 1969a) and VISSER & ZOER (1972) The trophic state of the water, in which the Eleocharetum multicaulis is found, is said to be oligotrophic by LEMEE (1937) LEBRUN et al (1949), PASSARGE (1955) and MULLER STOLL et al (1962), others have used the term „poor in nutrients" ALLORGE (1922), TUXEN (1937), BUKER (1939), WESTHOFF et al (1946), PIETSCH (1963) and PASSARGE (1964)

Dystrophic water was mentioned by LEMEE (1937), BURRICHTER (1969, he used the term oligo-dystrophic) and by DIERSSEN (1972), others mentioned mesotrophic water BENNEMA et al (1943) and GEHU (1964), BENNEMA et al (1943) even described a subassociation of somewhat eutrophic water These terms are not defined by the authors, however, so the paraphrase „eutrophic" may be not entirely adequate

More precise specifications of the water quality than „oligotrophic" or „poor in nutrients" are rare Some pH measurements are available most of them showing a distinctly acid water LEMEE (1937) found a pH of 5 2 and

6 5 in the Scirpetum fluitantis, and a pH of 4 4-5 3in the Helodeto-Sphagnetum, ALTEHAGE (1960) measured 5 6, and VISSER & ZOER (1972) measured values between 4 7 and 6 7 The values measured by VANDEN BERGHEN (1969a) are somewhat higher 6-7 in the Eleocharetum multicaulis, 6-7 in the Scirpeto americanae-Hypericetum elodis, and about 7 in the Scirpetum fluitantis These values correspond with the values measured by the present author, although higher and lower values did occur in the present investigation the highest pH (9 6 in rel 59 in France) is really exceptional

Only a few measurements of ions have taken place VANDEN BERGHEN (1967) mentions 8-11 mg Ca^{2+}/l and 35 mg Cl^{-}/l in some south western French lakes, whereas I measured 2-4 mg Ca^{2+} and 25-34 mg Cl^{-}/l in some of these lakes In the „etang de Lacanau" VANDEN BERGHEN (1968) measured 16-20 mg Ca^{2+} and 55 65 mg Cl^{-}/l, my values are 2 4 and 34 mg/l respectively

VISSER & ZOER (1972) published values of pH, electrical conductivity and some ions relating to their Potameto-Hypericetum-table, the conductivity values were between 36 and 158 µS, average 82, which is lower than the values found by the present author, especially for Ireland

VISSER & ZOER (1972) have taken three water samples of which they measured, among others, the Cl^{-} Ca^{2+}, Na^{+} and K^{+} content The values measured by the present author are all but one within the limits found by VISSER & ZOER (1972) Their Cl^{-}-amounts were 50, 10 and 14 mg/l, mine were 22-40 mg/l, their Ca^{2+} 6, 1 and 2 mg/l, mine 1 2 mg/l and once 14 mg/l, their Na^{+} 26, 5 and 7 mg/l, mine 25 and 16 mg/l, their K^{+} 0 5, 0 and 0 5 mg/l, mine 0 8 and 2 mg/l

Grazing in or near the sample plot is mentioned by BRAUN-BLANQUET (1964), ALTEHAGE (1960), VANDEN BERGHEN (1967, 1969b) and VISSER & ZOER (1972) This grazing has several influences on the vegetation it causes eutrophication by means of the faeces of the animals, on the other hand the animals trample down the tall eutrophilic plants that settle down as a consequence of the eutrophication These species may intercept the light necessary for the small species of the Eleocharetum multicaulis A comparable situation is described by WESTHOFF (1969) for the Isoeto-Lobelietum in an Irish lake The eutrophication does not seem to have a disadvantageous influence in the case of the communities mentioned by BRAUN BLANQUET (1964), VANDEN BERGHEN (1967, 1969b) and VISSER & ZOER (1972), but in the pool mentioned by ALTEHAGE (1960) the eutrophilic species are beginning to drive away the species of the Eleocharetum multicaulis

An exceptional case is seen in the Eleocharetum multicaulis stands mentioned by IVIMEY-COOK & PROCTOR (1966) from The Burren in Ireland The vegetation was found on a marl soil, where plenty of Ca^{2+} is present Most character taxa of the Eleocharetum multicaulis apparently cannot tolerate such a calcareous soil and are therefore absent *Hypericum elodes, Deschampsia setacea* and *Potamogeton polygonifolius Scirpus fluitans*, absent in the association, was found on the calcareous soil elsewhere *Eleocharis multicaulis* was the only character taxon of the association left, but it seemed to tolerate this habitat quite well Other Littorelletea species found in the stands were *Echinodorus ranunculoides, Juncus bulbosus* and *Littorella uniflora*

Open spots in Eleocharetum multicaulis stands can offer a suitable habitat for the Cicendietum filiformis juncetosum mutabilis (DIEMONT, SISSINGH & WESTHOFF 1940, DURING 1973) The Eleocharetum multicaulis can be considered the warp community, and the Cicendietum filiformus the woof community. Both terms will be explained in detail at the Eleocharetum acicularis (V 4)

V.2.4 Synchorology

The association has a highly atlantic character due to the (sub)atlantic distribution of its character taxa

The distribution of the association shows a more or less continuous area from Schleswig-Holstein through north western Germany, eastern and southern Netherlands, Belgium and north western France In Brittany and in Les Landes the association is well spread, also in Scotland and western Ireland Isolated areas are found in East Germany and in Spain

In previous publications the association has been mentioned most frequently from France from Brittany by VANDEN BERGHEN (1958), LENOIR (1958), LAMBINON & DUVIGNEAUD (1962), BEEFTINK (1962), GÉHU (1964) and DELVOSALLE & GEHU (1969), from Les Landes by ALLORGE & DENIS (1923), JOVET (1951) and VANDEN BERGHEN (1964, 1967, 1968, 1969a, 1969b, 1971), from the Massif de Multonne by ALLORGE (1924) and LEMEE (1932), from Le Vexin by ALLORGE (1922), from La Sologne by ALLORGE & GAUME (1931), from the region of Brigneil by CHOUARD (1925), from le Lac de Grand-Lieu by GADECEAU (1909) and from Le Perche by LEMÉE (1937)

The association was mentioned from different parts of north western

Germany by SCHWICKERATH (1933), CHRISTIANSEN (1935), TÜXEN (1937), BÜKER (1939), PFEIFFER (1945), ALTEHAGE (1957, 1960), ERNST (1967), BURRICHTER (1969) and DIERSSEN (1972). OBERDORFER (1957) noted a fragmentary Eleocharetum multicaulis in south western Germany. In east Germany the association is only found in the Lausitz, a region south of Berlin. In this region many (sub)atlantic species occur, among others character taxa of the Eleocharetum multicaulis; the association was mentioned by PASSARGE (1955), MÜLLER–STOLL et al. (1962), PIETSCH (1963) and KRAUSCH (1969). In Denmark the association is reported by JESSEN (1927).

The area in The Netherlands is a continuation of the north western German area; the association is found mainly in the eastern and southern part of the country, and is mentioned by BENNEMA et al. (1943), MÖRZER-BRUYNS & PASSCHIER (1943), WESTHOFF et al. (1946), WESTHOFF (1951), VAN DONSELAAR (1961), VAN DER VOO (1962, 1966), KLEUVER & VAN DER VOO (1962) and WESTHOFF & DEN HELD (1969). The association is also found on the west Frisian island of Terschelling (WESTHOFF 1947, 1958).

In Ireland the association occurs along almost the whole west coast: BRAUN–BLANQUET & TÜXEN (1952), IVIMEY–COOK & PROCTOR (1966), SCHOOF–VAN PELT & WESTHOFF (1969) and VISSER & ZOER (1972).

The is not mentioned in previous publications from Scotland or the Lake District, although some of the character taxa occur there; British vegetation investigators did not use the description and classification methods of the French-Swiss School. The association was found in northern Scotland by the present author however.

In Spain the association occurs in Galicia (TÜXEN & OBERDORFER 1958) and in the Pays Basque (BRAUN–BLANQUET 1967). The association is reported from Morocco by DAHLGREN & LASSEN (1972).

V.2.5 Discussion: Comparison of the tables with each other and with data published before

I subassociation of *Potamogeton polygonifolius*

Ia1 variant of *Scirpus fluitans*, subvariant of *Apium inundatum*.

There appears to be a great resemblance between the relevés made by W. Diemont and G. Sissingh in The Netherlands and the

French relevés made by the present author
Echinodorus repens is seen in the French relevés only W Diemont and G Sissingh did not distinguish *Echinodorus repens* from *E ranunculoides*
KERN & REICHGELT (1950) published a list of localities with *Echinodorus repens* in The Netherlands The species was not mentioned from the localities where W Diemont and G Sissingh had made their releves of this subvariant Therefore, *Echinodorus ranunculoides* s l in these relevés probably is *E ranunculoides* s s
The Potametea are far better represented in the French relevés than in the Dutch releves
Communities that are more or less comparable to this subvariant have been noted by ALLORGE (1922), SCHWICKERATH (1933), CHRISTIANSEN (1935) and TUXEN (1937)
The „association of *Scirpus fluitans* and *Potamogeton polygonifolius*", mentioned by ALLORGE (1922) and SCHWICKERATH (1933) differs from the present subvariant by the absence of *Eleocharis multicaulis* and by the presence of *Littorella uniflora* The association is said to be best developed in water deeper than 1 m, in shallower water mixtures with the Eleocharetum multicaulis are found CHRISTIANSEN (1935) mentioned the same association, without *Hypericum elodes* however, as this species is lacking in the area investigated by the author, in Schleswig-Holstein
In TUXEN (1937) the subassociation of *Potamogeton polygonifolius* of the Eleocharetum multicaulis shows a great similarity with the subvariant under consideration, by the presence of *Hypericum elodes, Eleocharis multicaulis, Scirpus fluitans, Apium inundatum* and *Potamogeton polygonifolius* The presence of *Deschampsia setacea* and *Littorella uniflora*, however, distinguishes TUXEN's subassociation from the releves published here TUXEN (1937) did not mention *Luronium natans* and *Myriophyllum alterniflorum*
In DELVOSALLE & GÉHU (1967) the vegetation of pools in the southern part of Brittany is mentioned No reference is made of the species *Apium inundatum, Luronium natans* and *Echinodorus repens*, although these species have been found frequently in the same region by the present author

Ia2 typical subvariant

This subvariant is represented by relevés from The Netherlands, France and Ireland In all releves except the one made by the present author, the presence degree of ecotone species such as *Hydrocotyle vulgaris, Agrostis canina* and *A stolonifera* is higher than in the preceding subvariant This would imply that there is more disturbance in the habitat of this subvariant, it may be caused by the shallower water and the shores running dry in summer The Irish relevés differ from the French and Dutch ones by the presence of *Eriocaulon septangulare*, and by the great share of character taxa of the Parvocaricetea.
The latter taxa are indicators of mesotrophic to eurotrophic habitats The Eleocharetum multicaulis is found in western Ireland mainly in slightly eutrophicated sites, as is explained on page 74 already In the light of these facts the presence of character taxa of the Parvocaricetea is easily accounted for
In previous publications, communities comparable to this subvariant have been mentioned by CHOUARD (1925), VAN DIJK & WESTHOFF (1960), GEHU (1964), BURRICHTER (1969) and VISSER & ZOER (1972)
In CHOUARD's (1925) „association of *Potamogeton polygonifolius* and *Rhynchospora alba*" the „facies of *Potamogeton polygonifolius* and *Utricularia minor*" resembles this subvariant very much, let alone that *Sphagnum auriculatum* is a constant species in CHOUARD's table Although *Utricularia minor* is one of the name-giving species of CHOUARD's facies, it is recorded by that author in one out of ten relevés only, which corresponds with its presence degree in the present table
VAN DIJK & WESTHOFF (1960) published a releve which can be considered an impoverished specimen of the present subvariant Only five species occur in the releve, among which there are *Eleocharis multicaulis, Potamogeton polygonifolius* and *Scirpus fluitans*
In GÉHU (1964) a comparable community is mentioned, similar to CHOUARD's community by the high cover of *Sphagnum auriculatum*
VISSER & ZOER (1972) published a table with releves from western Ireland which they classified into the Potameto-Hyperícetum elodis In the majority of the releves *Eleocharis multicaulis* is present besides the two name-giving species

According to BRAUN-BLANQUET & TUXEN (1952) *Eleocharis multicaulis* does not occur in a pure Potameto-Hypericetum elodis If the species is found together with *Potamogeton polygonifolius* and *Hypericum elodes*, the vegetation represents a mixture of the Potameto-Hypericetum elodis and the Eleocharetum multicaulis To the opinion of the present author, however, the species combination described under the name Potameto-Hypericetum elodis by BRAUN-BLANQUET & TUXEN is an exceptional case, whereas the combination of *Potamogeton polygonifolius* and *Hypericum elodes* with *Eleocharis multicaulis* represents the normal case VISSER & ZOER (1972) discuss the higher syntaxa into which *Potamogeton polygonifolius* and „related species (*Hypericum elodes*)" should be classified the Littorellion or the Hypericion elodis, alliances of the Littorelletea, or the Potamion polygonifolii, an alliance of the Luronio-Potametalia (Potametea) The authors have chosen a fourth possibility, viz a Potameto-Hypericetum elodis (Muller & Gors 1960) within the Potamion graminei, an alliance of the Luronio-Potametalia They consider the growth forms a good argument for their decision The association could also be conceived as an oligotrophic pendant of associations of the Callitricho-Batrachion, according to the authors They also state that „the connection with the Littorelletea is vague", „only *Eleocharis multicaulis* and *Juncus bulbosus* remind to this class, indirectly, by way of the shore vegetation" According to VISSER & ZOER *Potamogeton polygonifolius*, *Hypericum elodes* and *Scirpus fluitans* are to be considered character taxa of the Potameto-Hypericetum elodis

If however these species are taken for character taxa of the Eleocharetum multicaulis, as is done by the present author on the base of material from a much larger area, then the Eleocharetum multicaulis appears to be well represented in the releves published by VISSER & ZOER, the three mentioned species plus *Juncus bulbosus* cover more than 50% per relevé, on the average

BURRICHTER (1969) published four releves, representing Eleocharetum multicaulis communities comparable with subvariant Ia2 In BURRICHTER's releves the high cover degree of *Ranunculus ololeucos* is striking

Ib1 typical variant, typical subvariant

The Scottish releves are much poorer in species than the Irish ones, *Eriocaulon septangulare, Hypericum elodes* and *Deschampsia setacea* are absent respectively extremely rare in the northern part of Scotland, from where the relevés are derived.

In The Netherlands comparable communities have been mentioned by VAN DONSELAAR (1961), and in France by LEMÉE (1937), VANDEN BERGHEN (1968) and TOUFFET (1970)

In LEMÉE (1937) the „variété des étangs" of the Helodeto-Sphagnetum corresponds best with the present subvariant. LEMÉE (1937) distinguished two ecological „varietés" within this „variété des etangs", of which the one found on the temporary humid shores corresponds best In the second ecological „variété", the „facies inondé", *Sphagnum* species are absent, therefore it is different from the subvariant under consideration

The Helodeto-Sphagnetum Lemée is also mentioned by TOUFFET (1970), the association was reported from lakes and pools and from brooklets and bogs.

VANDEN BERGHEN (1968) described the vegetation of the „anses indondées à *Scirpus* (= *Eleocharis*) *multicaulis*" from south western France, they represent tiny bays isolated from the large lake by a ridge of sand Despite the large sample plots (100 m^2) the table looks homotonous, and the similarity with the present subvariant can easily be detected In the relevés of VANDEN BERGHEN (1968) no *Sphagnum* species is present The water in the bays may be too rich in nutrients for *Sphagnum* species, it is derived from the mesotrophic large lakes, but gets isolated during the summer when the water level decreases

In VAN DONSELAAR (1961) a relevé of an impoverished Eleocheratum multicaulis is shown, with *Hypericum elodes* and *Potamogeton polygolifolius* as the most characteristic species *Scirpus fluitans* was found in a different site in the same pool

Ib2 subvariant of *Carex lasiocarpa*

The combination of the species *Potamogeton polygonifolius* and *Carex lasiocarpa* seems to be very uncommon, relevés with these two species have only been published by VAN DIJK & WESTHOFF (1960) They are derived from the same pool where some of the relevés from the present table have been made The pool has also been visited by the present author, but *Potamogeton polygonifolius* was not discovered any more.

II subassociation of *Littorella uniflora*

Although many authors have mentioned the occurrence of *Littorella uniflora* in the Eleocharetum multicaulis (TUXEN (1937), BUKER (1939), MORZER BRUYNS & PASSCHIER (1943), PFEIFFER (1945), BRAUN-BLANQUET & TUXEN (1952), ALTEHAGE (1957, 1960), MULLER-STOLL et al (1962), GEHU (1964), VANDEN BERGHEN (1967), SCHOOF-VAN PELT & WESTHOFF (1969), STRULLU (1970), TOUFFET (1970)), the combination of *Littorella uniflora* and *Scirpus fluitans* in the Eleocharetum multicaulis as in the subvariants IIa1 and IIa2 is hardly mentioned

IIa1 variant of *Scirpus fluitans*, subvariant of *Deschampsia setacea*

In this subvariant the average species number is the highest found in the Eleocharetum multicaulis, viz 18, and 14 species out of the total of 31 are present in over 60% of the releves This gives the table a very homotonous appearance

Slightly comparable to this subvariant is the variant of *Galium palustre* of the typical subassociation of the Eleocharetum multicaulis, as seen in DIERSSEN (1972) His releves are different from the releves published here mainly by the lack of *Littorella uniflora, Carex serotina, Scirpus fluitans* and *Apium inundatum* Both tables correspond by the presence of *Eleocharis multicaulis, Deschampsia setacea, Galium palustre* and *Ranunculus flammula*

In PFEIFFER's (1945) table of the Eleocharetum multicaulis only one releve contains the species *Eleocharis multicaulis, Scirpus fluitans, Deschampsia setacea* and *Littorella uniflora* The greatest difference with the present releves is the absence of *Apium inundatum, Juncus bulbosus* and *Carex serotina*

In the subassociation of *Agrostis canina* var *stolonifera* belonging to the *Eleocharetum multicaulis*, TUXEN (1937) did not mention *Littorella uniflora, Carex serotina* and *Galium palustre* whereas *Deschampsia setacea* was noted in a few releves only

IIa2 typical subvariant

Except for *Deschampsia setacea* the floristic composition of this subvariant does not differ essentially from the former subvariant

In BUKER (1939) two comparable releves from Germany are given, and there is one releve in PFEIFFER (1945) and in VANDEN BERGHEN (1967, rel 20 in table I) In the last mentioned table *Scirpus fluitans* presents a higher cover degree in stands without *Littorella uniflora* STRULLU (1970) published a synoptic table of a community which can be assigned to the Eleocharetum multicaulis, in part of the relevés *Scirpus fluitans* is found besides *Littorella uniflora, Eleocharis multicaulis* and other species

IIb1 typical variant, subvariant of *Deschampsia setacea*

Hypericum elodes, Littorella uniflora and *Carex serotina* reach the highest presence degree in the oldest Dutch relevés (table 7), whereas in the later Dutch releves these species have a lower presence degree This phenomenon of syntaxa getting poorer in Littorelletea character taxa in the course of time has been observed in other associations at well It is probably due to the deterioration of the habitat.

The ecotone species *Agrostis canina* and *Hydrocotyle vulgaris* are frequent in the Scottish releves they are absent, however *Molinia caerulea* is a common species in this subvariant and so are the bryophytes

Relevés of this subvariant have been published by LEMÉE (1937), MORZER-BRUYNS & PASSCHIER (1943), PFEIFFER (1945) and ALTEHAGE (1957).

In LEMÉE's (1937) table of the „Heleochareto-Littorelletum" one relevé is present with *Littorella uniflora, Deschampsia setacea* and *Carex serotina* With the exception of *Deschampsia setacea* no character taxa of the Eleocharetum multicaulis are present, which makes the relevé only a fragmentary representative of the subvariant and the association

The relevés published by MORZER-BRUYNS & PASSCHIER (1943), PFEIFFER (1945) and ALTEHAGE (1957) are good representatives of the subvariant

VAN DER VOO (1962, p 53) mentions *Littorella uniflora* and *Deschampsia setacea* to occur together in one pool, but it is not clear whether they occur in the same site

IIb2 typical subvariant

This subvariant is best represented in the relevés made by the present author in The Netherlands and in France *Hypericum elodes* usually has a low presence degree In the French releves *Mentha aquatica* is very frequent, and in the Dutch releves of the present author *Sphagnum crassicladum*

Communities like this subvariant have been mentioned by BRAUN-BLANQUET & TUXEN (1952), PASSARGE (1955), ALTEHAGE (1960), MULLER-STOLL et al (1962) and GEHU (1964)

The relevés of the Eleocharetum multicaulis published by BRAUN-BLANQUET & TUXEN (1952) are very similar to the Irish relevés of this subvariant, rendered in table 13

The relevés of PASSARGE (1955) and MULLER-STOLL et al (1962) are rather strongly impoverished in comparison to the relevés published here, this has to be explained chorologically, since many species in question do not occur that far east as the sites of PASSARGE and MULLER-STOLL et al

The pool of ALTEHAGE's (1960) relevés is situated far more west, which enables the occurrence of (sub)atlantic species such as *Hypericum elodes, Deschampsia setacea* and *Pilularia globulifera*.

A great similarity exists between the French relevés 21 and 22 of table 10 and the relevés noted by GÉHU (1964), this is due to the fact that they are derived from the same pool

IIIa impoverished subassociation, variant of *Scirpus fluitans*

In the Dutch relevés *Hypericum elodes* is more frequent than *Eleocharis multicaulis*, which is different from the situation found in the former syntaxa.

This variant is intermediate between the subassociations I and II, and the fragments IVa and IVb In these fragments disturbed conditions prevail, the habitat in variant IIIa is also disturbed, but to a lesser extent This is especially true in the most recent Dutch relevés, made by the present author, all releves are derived from metatrophic habitats

In this variant ecotone species are well represented, except in the Irish material It seems that this variant needs a slight disturbance, for instance a slight eutrophication But in the densely populated countries with a high technical civilization standard, however, such as the Netherlands and parts of France, and particularly in the last few decennia, a slight eutrophication usually is the beginning of a cumulative process leading to an enormous eutrophication, a strong disturbance In sparsely populated areas, such as western Ireland and northern Scotland, a steady state is possible in which a slight eutrophication is incorporated. There is no disturbance in that case, and the ecotone species are absent.

In BRAUN-BLANQUET (1967) three relevés belonging to the „Hyperico-Isolepidetum (= Scirpetum) fluitantis" are published; they correspond reasonably with the relevés of the present variant, although *Eleocharis multicaulis* is lacking and although some species with a southern distribution are present. The relevés are derived from ecotone habitats: a contact vegetation of the shallow shore between pools with more than 1 m of water on one side, and meadows where cattle graze on the other side. These relevés could easily be classified into the impoverished subassociation of the Eleocharetum multicaulis, but BRAUN-BLANQUET (1967) has conceived them as a separate association. In the table published by BRAUN-BLANQUET *Echinodorus ranunculoides* var. *repens* (= *E.repens*) is present in all relevés; it is striking that this species reaches a high presence degree only in the French relevés of the present author. This may reflect the rather mediterranean character of the species (MULLENDERS 1967). In the relevés of table 8 *Lysimachia vulgaris* is rather frequent; *Sphagnum crassicladum* s.l. is found in all relevés except in the relevés of W. Diemont and G. Sissingh (table 7).

VAN DIJK & WESTHOFF (1960) have shown a comparable relevé from a disturbed habitat; in an originally oligotrophic pool pollution had taken place. The relevé has been made two years after the pollution was stopped and the pool was cleaned. The vegetation had not yet reached an equilibrium apparently.

VANDEN BERGHEN (1967) showed comparable relevés from south western France, in which *Scirpus americanus* was an important species. TOUFFET (1970) mentioned the occurrence of the Scirpetum fluitantis in Brittany in France: the association is said to occur in less acid water than the Helodeto-Sphagnetum.

IIIb impoverished variant

This variant is not represented by relevés of W. Diemont and G. Sissingh (table 7). It is unlikely that these communities were not present at that time (around 1940); but there were plenty of well developed Eleocharetum multicaulis, Isoeto-Lobelietum, Pilularietum etc. communities.

The French and Irish relevés are less impoverished than the remaining relevés, since *Hypericum elodes* is present. In Ireland

and France *Eleocharis multicaulis* was accompanied usually by *Hypericum elodes*, this may indicate that the very poor habitats, where only *Eleocharis multicaulis* occurs, are rare in those countries, at least in the regions visited by the present author This supports VAN DONSELAAR (1970), who states that the extremely oligotrophic pools in western Europe are most frequent and best developed in The Netherlands The water analyses are brought into memory in the French and Irish waters the Cl^- content was much higher than in Scotland or The Netherlands

Sphagnum crassicladum s l does not seem to be influenced unfavourably by the relatively high Cl^- content, which is noted in the Irish releves of this variant

Impoverished Eleocharetum multicaulis stands with *Sphagnum* species have been reported by LEBRUN et al (1949), ALTEHAGE (1957) and DIERSSEN (1972)

In eastern parts of Europe differently impoverished Eleocharetum multicaulis communities have been observed by PASSARGE (1955) and MULLER STOLL et al (1962), in their releves no *Sphagnum* species are found The association is impoverished because most of the character taxa do not occur that far east

IVa + IVb fragments facies of *Scirpus fluitans* and of *Hypericum elodes*

Such fragments are not reported in table 7, probably because the moorland pools were relatively undisturbed in that time

Little has been published before about these fragments ALLORGE (1922) mentions the association of *Scirpus fluitans* and *Potamogeton polygonifolius* in deep, man made pools and he considers this association the first stage in the succession Although his association is not as fragmentary as the facies in the present work, it occurs in a habitat with a dynamic nature The steep slopes and the strongly fluctuating water level only add to it

LEMEE (1937) considers the assosiation of ALLORGE (1922) a mixture, and he describes a Scirpetum fluitantis This association is found in the central part of man made, oligotrophic pools According to LEMEE (1937) the association is only found in stable habitats fluctuations in the water level do not favour the association

The interesting combination of *Scirpus fluitans* and *Ludwigia palustris* as occurs in table 10 is mentioned by VANDEN

BERGHEN (1969a, 1971) who considers the community an independent association, the Scirpetum fluitantis This association is found in sites with a fluctuating water level and frequent visits of cattle, which suppress the growth of tall species *Juncus effusus* is frequent, as a consequence of those visits

VAN DONSELAAR (1961) mentions a dominance community of *Hypericum elodes* along the steep slope of a former river bed In VANDEN BERGHEN (1949) a similar vegetation in similar circumstances is seen

V.2.6 Other representatives of the Eleocharetum multicaulis

In VANDEN BERGHEN (1969a) four associations are mentioned which are more or less similar to the Eleocharetum multicaulis in the conception of the present author the Thorello submersae-Littorelletum and the Eleocharetum multicaulis, both assigned to the Eleocharition multicaulis by VANDEN BERGHEN, and the Scirpeto americanae-Hypericetum elodis and the Scirpetum fluitantis, both classified into the Helodo Sparganion The sample plots underlying the tables are usually very large $100 \ m^2$ is no exception Therefore species from adjacent communities may be included *Littorella uniflora* and *Thorella verticillata inundata*, character taxa of the Thorello submersae-Littorelletum*, are present in one respectively two of the other associations, in some cases even with higher presence degree The third character taxon of the association, *Juncus pygmaeus* fo *submersus*, was found in the Thorello submersae Littorelletum only with a presence degree of I The character taxon of VANDEN BERGHEN's Eleocharetum multicaulis, *Eleocharis multicaulis*, occurs in the other association with presence degrees between III and V! *Hypericum elodes* and *Echinodorus ranunculoides*, character taxa of the Scirpeto americanae-Hypericetum elodis, are found in all four associations, with a high presence degree *Thorella verticillata-inundata* is said to be a character taxon of this association as well! The fourth character taxon of the Scripeto americanae-Hypericetum eloids, *Galium debile*, does not reach more than presence degree II in this association, whereas in the Scirpetum fluitantis it has a presence degree V!

In this last mentioned association the character taxon, *Scirpus fluitans*, has

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*) This association is named after *Thorella verticillata inundata* fo *submersa* by VANDEN BERGHEN (1969a) the author does not distinguish between the various forms of the species in the tables, however

a presence degree V, in the other associations it was only I, II or III

The difference between these four associations is not great, therefore, and they should not be classified into two alliances They should all be considered representatives of the Eleocharetum multicaulis, to the opinion of the present author Within the association subassociations and variants could be distinguished

VANDEN BERGHEN (1964, 1969a) also published tables of the Rhynchosporetum atlanticum (1964) or the Rhynchosporetum albae, as it was called in 1969 Here *Rhynchospora fusca* is the dominant species, and *Deschampsia setacea, Eleocharis multicaulis, Hypericum elodes* and *Echinodorus ranunculoides* are constant species with a low combined estimation

The association is found on those parts of the shores of lakes, which run dry first, in spring *Rhynchospora fusca, R alba* and *Drosera intermedia* occupy the barren sand after the water has retreated In some cases a sparse Eleocharetum multicaulis vegetation is still present

In PIETSCH (1963) a table of the Eleocharetum multicaulis was published from the Lausitz, south of Berlin In his table the Potametea and Phragmitetea are well represented, whereas *Hypericum elodes, Deschampsia setacea, Echinodorus repens* and *Ranunculus ololeucos* are absent *Scirpus fluitans* is said to be very rare PIETSCH (1963) distinguishes two subassociations, which are similar to the associations found in ALLORGE (1922) and the subassociations in TUXEN (1937)

V.3 Pilularietum globuliferae (Tuxen, ex Muller & Gors, 1960)

V.3.1 Introduction

The Pilularietum globuliferae was mentioned by TUXEN (1955) for the first time as a separate association he did not give any details about this association, however, but only published the name The first diagnosis of the Pilularietum was given by MULLER & GORS (1960), they published a synoptic table that was composed of (unpublished) releves of BENNEMA et al (1943) and of releves, published by TUXEN (1937) under the name of Eleocharetum acicularis

The Pilularietum has been accepted by DEN HARTOG & SEGAL (1964), PIETSCH (1965 1971), SEGAL (1965, 1968) RUNGE (1966 1969), OBERDORFER et al (1967), WESTHOFF & DEN HELD (1969), PETRUCK

& RUNGE (1970) and DIERSSEN (1972).

In most of the previous publications *Pilularia globulifera* was considered a character taxon of the Eleocharetum multicaulis: GADECEAU (1909), ALLORGE (1922), ALLORGE & DENIS (1923), ALLORGE & GAUME (1931), SCHWICKERATH (1933), CHRISTIANSEN (1935), LEMÉE (1937), BUKER (1939), LEBRUN et al. (1949), WESTHOFF (1958) and ALTEHAGE (1960).

Pilularia globulifera is considered a character taxon of the Eleocharetum acicularis by MALCUIT (1928), BENNEMA et al. (1943), MÜLLER-STOLL et al. (1962), PIETSCH (1963), PASSARGE (1964) and PHILIPPI (1969). CHOUARD (1925) considered *Pilularia globulifera* a character taxon of the „association of *Littorella* and *Eleocharis*". In this association *Eleocharis palustris* is the most important *Eleocharis* species, both in abundance and in presence; *Eleocharis acicularis* is locally dominant, however. TÜXEN (1937) and PFEIFFER (1945) have published relevés belonging to the Eleocharetum acicularis, in which *Pilularia globulifera* was present as a character taxon of the *Littorellion*. WILMANNS (1968) mentions the frequent combination of *Pilularia globulifera* and *Eleocharis acicularis*.

Other phytosociologists have mentioned the occurrence of *Pilularia globulifera* in other syntaxa. ALLORGE (1922), SCHWICKERATH (1933) and CHRISTIANSEN (1935) considered *Pilularia globulifera* a character taxon of the „association of *Scirpus fluitans* and *Potamogeton polygonifolius*", an association which, to the opinion of the present author, has to be assigned to the *Eleocharetum multicaulis*. SCHWICKERATH and CHRISTIANSEN only consider *Pilularia globulifera* fo. *natans* the character taxon.

LEMÉE (1937) considers *Pilularia globulifers* fo. *natans* as the character taxon of the Scirpetum fluitantis, an association which, again, has to be assigned to the Eleocharetum multicaulis.

Pilularia globulifera was considered a character taxon of the Littorellion by SCHOOF-VAN PELT & WESTHOFF (1969); of the Helodo-Sparganion by OBERDORFER (1957) and of the Isoeto-Littorelletea by LOUIS & LEBRUN (1942). JONS (1934) distinguished a subassociation of *Pilularia globulifera* within the Isoetetum echinospori, Koch, 1926.

The occurrence of *Pilularia globulifera* has been mentioned in communities belonging to the: Scirpeto-Lobelietum by VANDEN BERGHEN (1964); Eleocharetum multicaulis by VANDEN BERGHEN (1967); Littorellion by NOIRFALISE (1966). WESTHOFF (1971) noted the fern in a vegetation with *Hypericum canadense*.

All these views, just mentioned, show a great variety of possibilities for the

Most phytosociologists have classified the communities with *Pilularia globulifera* into the Littorellion, whether or not they recognize a Pilularietum TUXEN (1937, 1955), BENNEMA et al (1943), MULLER & GORS (1960), MULLER-STOLL et al (1962), PIETSCH (1963), PASSARGE (1964), DEN HARTOG & SEGAL (1964), SEGAL (1965, 1968), RUNGE (1966, 1969), OBERDORFER et al (1967), WESTHOFF & DEN HELD (1969) and SCHOOF-VAN PELT & WESTHOFF (1969) PIETSCH (1965a, 1971) classified the Pilularietum into the Eleocharition acicularis, and DIERSSEN (1972) into the Hydrocotylo-Baldellion

Why the present author has chosen for a Pilularietum (a separate association) will be elucidated in this chapter

V.3.2 The present relevés (table 14)

Because only a limited number of releves is available, they have all been placed in one table

The Pilularietum globuliferae has been subdivided into

I subassociation of *Eleocharis acicularis*, Pilularietum globuliferae eleocharetosum acicularis

II subassociation of *Subularia aquaticae* P g subularietosum aquatica

III subassociation of *Eleocharis multicaulis*, P g eleocharetosum multicaulis

IV impoverished subassociation P g inops

V variant of *Littorella uniflora*

I subassociation of *Eleocharis acicularis* (releves 1 3)

This subassociation, which is floristically characterized by *Pilularia globulifera* and *Eleocharis acicularis*, can hardly be characterized ecologically Only three releves are available, moreover, they do not give sufficient information about the habitat The soil is known from rel 1 only it is a humous, black, muddy sand Releves 2 and 3 are derived from ditches In rel 2 the ditch traverses a meadow, and although the use of fertilizers was not as intense in that time (1939) as it is presently, the water of the ditch might be slightly eutrophic In the case of rel 3 the ditch traverses *Erica tetralix* moorland, and eutrophication is therefore

unlikely
The combination of the species *Pilularia globulifera* and *Eleocharis acicularis* was not seen in the present investigation, nor did the S O L investigators mention it This might indicate that the typical habitat of this subassociation has disappeared, at least in The Netherlands

II subassociation of *Subularia aquatica* (releves 4 and 5)
This subassociation has only been found in Ireland, it can be distinguished from the other subassociations by the presence of *Subularia aquatica* and *Eriocaulon septangulare*
The latter species has to be considered a geographically differential taxon for Ireland, since, in Europe, it occurs hardly outside of western Ireland
The present subassociation was found on a fine grain muddy soil, the water level was highly variable after a very dry month heavy rains caused the water to rise 70 cm within 2 days! Rel 4 was made on the shore of a river, rel 5 on the shore of the lake into which the river drained Cows walked through these sites, on their way to obtain drinking water, and therefore may cause eutrophication, the degree dependent on the frequency of the cow's visists
These releves have been published before, in a syntopic table, in SCHOOF-VAN PELT & WESTHOFF (1969)

III subassociation of *Eleocharis multicaulis* (releves 6 14)
Apart from *Eleocharis multicaulis* other character taxa of the Eleocharetum multicaulis are present *Scirpus fluitans, Hypericum elodes, Ranunculus ololeucos, Potamogeton polygonifolius, Deschampsia setacea* and *Echinodorus repens*
Some of these species occur in releves of the next subassociation but they never reach a presence as well as a cover degree as high as in this subassociation Moreover *Apium inundatum* distinguishes this subassociation from the next one
This subassociation is richer in species than the impoverished subassociation, this is due to the larger presence of the Eleocharetum multicaulis character taxa, of *Apium inundatum, Littorella uniflora* and *Echinodorus ranunculoides*, and to ecotone species Most releves are taken from shallow water or humid shores, only

one relevé was made in rather deep water (rel. 12 in 25 cm of water). In most cases the soil was muddy, but a peat or a sandy soil occurred occasionally.

Water analyses showed slightly acid water (pH 5.6-6.4) with a relatively high electrical conductivity (313, 337 and 380 μS). In the pool of rel. 10 a relatively high Cl^- content of 79 mg/l was measured; this pool is situated close to the sea and receives salt spray from the sea winds. BEEFTINK (1964) mentioned that this pool was visited by cattle in 1962; in 1969 no traces of cattle could be detected.

IV impoverished subassociation (relevés 15-24).

This subassociation cannot be characterized by the presence of any differential taxa, but only by their absence. The species that characterize the Littorelletea are poorly represented, and in rel. 21 *Pilularia globulifera* is their only representative. The average number of taxa in this subassociation (7) is much lower than in the former subassociation (17). *Glyceria fluitans, Alopecurus aequalis* and *Cardamine pratensis* are most frequent in the present subassociation. Both the first and the second species mentioned are N-indicators; this may suggest that the habitat of this subassociation is richer in N than the habitat of the other subassociations, although no measurements are available to confirm this presumption.

The water level in the stands was usually about the level of the soil surface, but a depth of 25-30 cm was measured once (rel. 20). Three pH-measurements show circumneutral water; the electrical conductivity measurements show two high values and one low value.

The soil consists of sand, which in some stands is covered with a thin (1-2 cm) layer of organic matter, mud or loamy clay; it appears to be more compact than in the subassociation of *Eleocharis multicaulis*.

Since *Hypericum elodes* and *Scirpus fluitans* prefer a weaker soil and since these species are among those having a higher presence degree in the former subassociation, the fact that the soil is more compact in the impoverished subassociation than in the subassociation of *Eleocharis multicaulis* may be responsible for the floristic differences between the two subassociations.

In some cases the habitat may also be too rich in nutrients to enable the character taxa of the Eleocharetum multicaulis to thrive, viz in relevés 17, 18, 19, 20 and 21

Relevés 17, 19 and 21 are derived from the same pool as relevés 8 and 13, but they are situated closer to a ditch, draining from fertilized agricultural land

In the pool of rel 20 rather severe drainage and eutrophication have taken place These disturbances do not seem to favour the Eleocharetum multicaulis species.

The pool of rel 18 received eutrophic water from sewage The French relevés 22, 23 and 24 are derived from a single pool that contained eutrophic water in which local facies of *Glyceria fluitans* and *Ranunculus aquatilis* occurred

The frequent visits of anglers were visible as footprints, in which *Pilularia globulifera* was growing luxuriantly. A moist trench near the pool shows the difference between treaded sites (releves 22, 23 and 24) and untreaded sites (this rel)

Pool, 1 km E of Loudeac, Cotes-du-Nord, Brittany, France ('69)

quadrat size	1 m^2
cover %	90
water depth (cm)	1
species number	19
character taxa of Littorelletea	
Pilularia globulifera	3 4
Juncus bulbosus	2m 2
character taxa and differentials of Agropyro Rumicion crispi	
Juncus articulatus	2m 2
Juncus effusus	1 3
Agrostis stolonifera	+ 1
character taxa of Phragmitetea	
Glyceria fluitans	2a 3
Lycopus europaeus	+ 1
character taxa of Potametea	
Ranunculus aquatilis	1 1
Callitriche spec	1 3

N-indicator	
Polygonum minus	2a 2
remaining species	
Galium palustre	2a 2
Ranunculus flammula	1 1
Lotus uliginosus	1 3
Peplis portula	1 3
Mentha aquatica	1 2
Carum verticillatum	+ 1
Carex serotina	1 2
Holcus lanatus	+ 1
mosses	
Calliergonella cuspidata	+ 1

Although the trophic level of the stands in question will be the same, the floristic differences between releves 22, 23 and 24 (treaded) on the one side, and this relevé (untreaded) on the other side are considerable Twelve species are present only in the latter relevé, the releves have only seven species in common Treading apparently keeps down a number of species

Relevés 15 and 16 represent an initial stage in a succession, where *Pilularia globulifera* was the first species to become established, while other species are just invading The chances for eutrophilic and ecotone species are poor, since the habitat is oligotrophic and no longer disturbed, in this case an Eleocharetum multicaulis stand may develop in a few years

V variant of *Littorella uniflora* (relevés 25-34)

These hitherto unpublished relevés were made by V Westhoff in 1938 and 1939 on the west Frisian island of Terschelling, they are all derived from a single pool, the „Doodemanskisten", the only recent locality of *Pilularia globulifera* on the west Frisian islands

The relevés have been classified into a variant instead of into a subassociation, since they are derived from the same site It is unknown if similar communities exist in other localities

Although the relevés of this variant are derived from the coastal region, - as opposed to the other relevés belonging to this association - they hardly contain any geographically differential taxa Of this group only *Carex serotina* ssp *pulchella*, *Oxycoccus macrocarpos* and *Carex trinervis* are found in a few relevés
The variant is characterized by the constant taxa *Pilularia globulifera*, *Apium inundatum*, *Littorella uniflora*, *Echinodorus ranunculoides*, *Eleocharis palustris* ssp *palustris* and *Hydrocotyle vulgaris* The character taxa of the Eleocharetum multicaulis are lacking The relatively high NaCl-content of the pool may be held responsible, since on the same island the Eleocharetum multicaulis does occur in pools, situated more inland, with a lower NaCl-content

V.3.3 Transects

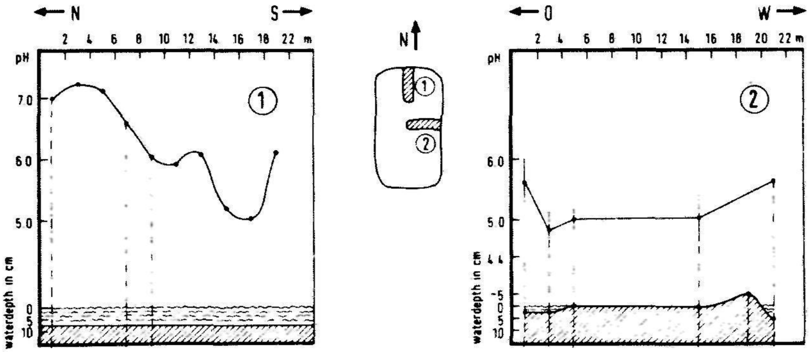
Two transects were made in the pool of the relevés 8, 13, 17, 19 and 21, in the skating-rink of the village of Schijndel, in North-Brabant in the Kempen district, the results are shown in fig 7

The skating-rink is a rectangular depression with a surface of 4 hectares, it was excavated some 15 years ago In wintertime the depression gets filled up on behalf of the skating activities, in summer it has no destination, and since no water is added, the water level falls to the surface or below in summer

The water of the pool is fairly rich in nutrients, since it is derived from agricultural land, as a consequence reeds grow in the pool, especially in the central and west part These reeds are cut back to the rhizomes every year, because they would be inconvenient to the skaters This treatment keeps the growth of reeds restricted and, moreover leaves plenty of light, food and space for the Pilularietum

The transect running from east to west has a length of 24 m, it consists of six releves and a number of pH- and water depth measurements The other transect, running north-south, has a length of 16 m, with three releves and 10 pH measurements

The differences between the two transects are rather conspicuous, the east-west transect is rich in species, whereas the north-south transect is poor in species, the pH in the east-west transect does not reach values as high as in the north-south transect, in the east-west transect the pH measured in about the same time was very changeable, the figure showing the average value of 2 measurements, plus the extremes; in the north-south transect one measurement appeared to be sufficient; in the last mentioned transect *Pilularia globulifera* was the dominant species, while the remaining species did not seem to be very important, at least not physiognomically; in the west-east transect the floristic composition was much more varied.



104	106	107		98	99	100	101	102	103
104	106	107	*relevé number*	98	99	100	101	102	103
80	95	80	*cover %*	95	90	100	100	100	95
5	7	8	*number of taxa*	16	23	14	16	17	14
5.5	5.5	5.5	*Pilularia globulifera*	5.5	4.4	3.3	1.2	2m.2	2m.2
			Juncus bulbosus	1.2	2m.2	4.4	4.4		2b.2
			Apium inundatum				1.3	2a.2	3.3
			Eleocharis multicaulis	+3		1.3	+2		
			Scirpus fluitans	1.3	2m.2	+2	1.2		
			Hypericum elodes	+2	1.2	+2		1.1	
	1.1	+1	*Ranunculus ololeucos*	1.2	1.2	+1			
			Eleocharis palustris ssp palustris	1.2	2a.3	+2	+1		
1.2	1.2	1.1	*Glyceria fluitans*		1.3				1.2
		1.1	*Alisma plantago-aquatica*	2m.2	2a.2	+1	1.2	1.1	1.2
		+1	*Equisetum fluviatile*	1.2	2m.2		1.2	+1	2m.2
			Typha latifolia	+1	2a.2				
			Phragmites australis					1.2	2m.2
			Myosotis scorpioides					1.2	
+1	+1		*Hydrocotyle vulgaris*	1.2	2a.2	2b.2	2a.2		2a.2
			Agrostis canina	+1	+1	+2	1.2	2m.2	1.2
			Juncus effusus					+1	
			Galium paluste	1.2	2m.2	2m.2	+1	2m.2	2m.2
	1.1	+1	*Ranunculus flammula*	1.2	1.2	1.2	1.2	1.2	2a.2
			Juncus articulatus		1.3		1.2		
			Lysimachia vulgaris	+1	+1			+1	
			Utricularia neglecta		1		3.3		+
			Lotus uliginosus		1.2	1.2		+1	
			Peplis portula	2a.2					
			Cardamine pratensis		+1				
			Eriophorum angustifolium		+1		1.1	1.2	
1.1	+2	+1	*Alopecurus aequalis*						
		+1	*Lemna minor*						
			Filamentous algae		x	x	x	x	x
			Sphagnum crassicladum					+	+
			Drepanocladus fluitans		1			1	
			Sphagnum cuspidatum		+				

Fig. 7. Transect from the skating-rink at Schijndel, North-Brabant.

V.3.4 Synecology

It appears from the relevés published here that the Pilularietum is usually found in a habitat richer in nutrients than most of the other Littorelletea associations. In some cases this could be shown by water analyses, and in other cases it could be shown, indirectly, by the presence of species that indicate eutrophic conditions.

These data are in accordance with WESTHOFF & DEN HELD (1969), who state that the Pilularietum occurs in somewhat disturbed (eutrophicated) sites.

Most phytosociologists, however, do not mention an enriched habitat; indications of a meso- or eutrophic habitat are given by STÅLBERG (1939), DIERSSEN (1972) and by BEEFTINK (1964). The last mentioned author published a relevé of a grazed depression, where *Pilularia globulifera* was found. The present relevés show a variety of soils: sand, silt, sand covered with organic matter, peat and loamy clay. The soils mentioned in literature are usually sandy: ALLORGE & DENIS (1923), LEMÉE (1937), TUXEN (1937), PFEIFFER (1945), MULLER-STOLL et al (1962) and PETRUCK & RUNGE (1970); a sandy-silty soil is mentioned by PASSARGE (1964) and RUNGE (1966, 1969). SAMUELSSON (1934) and CHRISTIANSEN (1935) assert that the substrate has to be poor in lime.

The soil of the association rarely becomes dry in summer, but the association can tolerate a moist soil: table 14, GADECEAU (1909), JONS (1934), PASSARGE (1964), WESTHOFF & DEN HELD (1969) and PETRUCK & RUNGE (1970). CHOUARD (1925) finds *Pilularia globulifera* especially in those parts of the „association of *Littorella* and *Eleocharis*", that have become dry. ALTEHAGE (1960) mentioned the dessication of the leaves of *Pilularia globulifera* upon the draining of the land

Strong fluctuations in the water level are mentioned by SCHOOF-VAN PELT & WESTHOFF (1969) and DIERSSEN (1972); the present investigation did not reveal such data, since most sites were visited once or twice

The pioneering character of the Pilularietum, as it is seen in the relevés 15 and 16, is mentioned by PHILIPPI (1969).

Open spots in Pilularietum communities can offer a suitable habitat to communities of the Cicendietum filiformis juncetosum mutabilis (DURING 1973).

V.3.5 Synchorology

The area of the association coincides more or less with the area of *Pilularia globulifera*, since *Pilularia globulifera* is the only character taxon of the association and since the character taxa of alliance, order and class more or less exceed this area. The area of *Pilularia globulifera* can be seen in MEUSEL (1965).

The association is not likely to be found in Italy or Yugoslavia, where localities of *Pilularia globulifera* occur, since the character taxa of the higher units are rare or absent there. Whether or not the association occurs in Portugal remains uncertain; some Littorelletea species are found there, but the Pilularietum has not been mentioned.

The association has a more or less continuous area in France (ALLORGE & DENIS 1923, VANDEN BERGHEN 1964, DELVOSALLE & GÉHU 1969); Belgium (LEBRUN et al. 1949, NOIRFALISE 1966); The Netherlands (WESTHOFF & DEN HELD 1969); north western Germany (TUXEN 1937, DIERSSEN 1972); Denmark (WIINSTEDT 1929, DURING 1973). southern Sweden (ALMQUIST 1929, SAMUELSSON 1934), and the British Isles (WEST 1910, PRAEGER 1934, SCHOOF-VAN PELT & WESTHOFF 1969).

Isolated occurrences of the association have been reported by PIETSCH (1963), MÜLLER-STOLL et al. (1962) and KRAUSCH (1969) from the Lausitz, south east of Berlin, and by ULBRICHT et al. (1963/1964) from Saxony. FUKAREK (1969) mentioned the occurrence of *Pilularia globulifera* in Mecklenburg, and CZUBINSKI (1950) in Poland; fragmentary association stands might be found there. According to CEDERCREUTZ (1947) *Pilularia globulifera* is found in one site in Finland; the association is not mentioned however.

The delimitation of the area of *Pilularia globulifera* within Ireland, as indicated by MEUSEL (1965) is incorrect, since the species is as frequent outside the outlined (= continuous) area as it is inside this area. Therefore Ireland as a whole will be considered as part of the area of the association.

V.3.6 Discussion

There is no uniform opinion about the synsystematic position of *Pilularia globulifera*. Most phytosociologists before 1960*) consider *Pilularia globuli-*

*) The year in which MULLER & GORS published the Pilularietum.

fera a character taxon of the Eleocharetum multicaulis After 1960 many phytosociologists consider *Pilularia globulifera* a character taxon of the Pilularietum Still other opinions also exist (see Introduction)

If one does not want to recognize a Pilularietum globuliferae, one may consider *Pilularia globulifera* a character taxon of the Eleocharetum multicaulis But a look at table 14 shows that *Pilularia globulifera* is not a good character taxon of that association, since it is also constant in other communities, such as listed in the subunits I, II, IV and V

One could consider *Pilularia globulifera* as character taxon of the Eleocharition acicularis (the alliance consisting of Eleocharetum multicaulis, Pilularietum, Eleocharetum acicularis and Samolo-Littorelletum), in that case the relevés of column I would represent a subassociation of *Pilularia globulifera* of the Eleocharetum acicularis, and the releves of column III a subassociation of the Eleocharetum multicaulis But the relevés of the columns II, IV and V, not belonging to any association, could only be regarded as „communities of *Pilularia globulifera* within the Eleocharition acicularis"

If one considers *Pilularia globulifera* the character taxon of the Pilularietum, however, all these difficulties are omitted, the table then represents 5 subunits (subassociations, variants) of the association

So the Pilularietum will be recognized by the present author, not only for practical purposes, but also because the association can be well characterized syntaxonomically, synecologically and synchorologically

Only a few phytosociologists have published releves of the Pilularietum MULLER & GORS (1960), MULLER-STOLL et al (1962), PIETSCH (1963), PHILIPPI (1969), PETRUCK & RUNGE (1970) and DIERSSEN (1972)

The synoptic table of MULLER & GORS (1960) consists partly of releves of BENNEMA et al (1943), since MULLER & GORS (1960) omitted the companions in their table, it was thought to be appropriate to publish these (three) releves again, as separate releves and provided with the companions

BENNEMA et al (1943) classified these releves into the Eleocharitetum acicularis, probably after TUXEN (1937) It appears from the releves published here and from relevés published by others, that *Pilularia globulifera* cannot be considered a character taxon of that association, since it occurs in other units with a high constancy and cover degree as well

DIERSSEN (1972) distinguished three subassociations within the Pilularietum a subassociation of *Apium inundatum* with two variants, a typical subassociation, and a subassociation of *Eleocharis acicularis*

The present variant of *Littorella uniflora* is similar to DIERSSEN's subassociation of *Apium inundatum*, and it is intermediate between both variants of this subassociation However, the present variant cannot be named after *Apium inundatum*, since that species has the same presence and cover degree in the subassociation of *Eleocharis multicaulis*

The typical subassociation of DIERSSEN (1972) is almost identical to the impoverished subassociation of the present work (column IV) It is incorrect to the opinion of the present author that DIERSSEN (1972) considers this subassociation the typical subassociation, since it is very poor in species, only *Pilularia globulifera* and *Juncus bulbosus* representing the Littorelletea The suffix „inops", taken from WESTHOFF (1965), and used in the present work, is more appropriate to characterize this syntaxon than „typicum" The subassociation of *Eleocharis acicularis* in DIERSSEN (1972) is similar to the subassociation with the same name in the present work

In the eastern border area of the area of *Pilularia globulifera* most character taxa of the Eleocharetum multicaulis are absent or rare, whereas *Eleocharis acicularis* far exceeds that area eastwards *Pilularia globulifera* and *Eleocharis acicularis* are found together more frequent than in the western part of Europe MULLER STOLL et al (1962), PIETSCH (1963) and PHILIPPI (1969) PIETSCH (1965) even distinguished an Eleocharition acicularis, into which the Pilularietum was classified

As mentioned before, ALLORGE (1922), SCHWICKERATH (1933) and CHRISTIANSEN (1935) consider *Pilularia globulifera* fo *natans* a character taxon of the „association of *Scirpus fluitans* and *Potamogeton polygonifolius*", and *Pilularia globulifera* without further specifications a character taxon of the „association of *Eleocharis multicaulis* and *Carex rostrata*"

But since a form is only a modification of the species, there is just one taxon which cannot be the character taxon of two associations within the same area

The releves and lists of ALLORGE (1922) and SCHWICKERATH (1933) containing *Pilularia globulifera* show that both mentioned associations include a number of eutrophilic species, such as *Polygonum amphibium, Glyceria fluitans, Lemma minor* and *Potamogeton natans* in the „association of *Scirpus fluitans* and *Potamogeton polygonifolius*," and *Typha latifolia, Scirpus lacustris* and *Carex vesicara* in the „association of *Eleocharis multicaulis* and *Carex rostrata*" This picture fits well into the previously mentioned data about the synecology of the Pilularietum, we have seen that they are found, at least by the present author, in richer habitats than most of the other Littorelletea associations The absence of oligotrophic species in table 14, such as *Utricularia minor, U. intermedia, Eriophorum angustifolium* and *Molinia caerulea*, points to the same conclusion.

A consequence of the mesotrophic habitat, in which the Pilularietum is best developed, is that fast growing species with a large biomass develop. These species intercept light, space and food of the Pilularietum, which implicates that the association will vanish sooner or later. So the Pilularietum can be maintained only under special circumstances.

In the mesotrophic skating-rink of Schijndel (rel. 8, 13, 17, 19 and 21 and the transects) the reeds and other tall plants are impeded in their growth, because the site is cut back every year. Here a positive influence of man is demonstrated; without his intervention the Pilularietum would probably be overgrown in a few years.

A comparative situation is present in the pool of relevés 22, 23 and 24; in this case the tall plants do not flourish because they are treaded down by the anglers. On sites where the treading was less severe, the vegetation was far more luxurious, as has been shown in the relevé on page 96. In the pool of rel. 18 a different situation prevails. The Pilularietum occurs in the contact zone of an oligotrophic and a eutrophic habitat. The pool contains eutrophic water, derived from the sewage of a weekend-cottage. The surface of the white, opaque water is covered with a dense *Potamogeton natans* vegetation, and parts of the shore are overgrown with *Juncus effusus, Eleocharis palustris, Lycopus europaeus, Typha latifolia* and *Phragmites australis*. Around the pool there was an unfertilized lawn, which represented the oligotrophic habitat.

Since the oligotrophic situation is dominant over the eutrophic situation (the oligotrophic habitat is situated higher), a stable gradient, a „limes divergens", arises (VAN LEEUWEN 1966). Such stable gradients are often found to hold rare species, in this particular case *Pilularia globulifera*.

The pool of relevés 11, 12, 15 and 16 is presently more oligotrophic than the pools that have been mentioned before. This pool used to receive water from the brook „Beerze" in wintertime, through which the water of the pool became moderately enriched. Since World War II, the brook has become polluted, however, by the increase of artificial fertilizers used in agriculture, and consequently the vegetation of the pool was threatened by the development of tall, mesotrophilic and eutrophilic species. In 1961 a dike was built to prevent the „Beerze" from flowing through the pool, and part of the intruding eutrophilic vegetation was removed. The vegetation of the pool is developing into an oligotrophilic direction now, although indicators of the previous situation are still present: *Potentilla palustris, Lysimachia vulgaris* and *Lythrum salicaria*. They do not expand however.

Rel. 12 was made before the construction of the dike, on one of the few sites where *Pilularia globulifera* survived in that time. Now the species can be found in many locations, especially in the bare areas that originated by the construction of the dike. This agrees well with the pioneer character of the species, mentioned by PHILIPPI (1969).

The two Irish relevés, 4 and 5, are characterized by a typical habitat, of which the fine-grain, weak silty soil is the most prominent factor. The water level fluctuates strongly, probably because the sites are influenced by running water; most other pools have stagnant water.

The transects

In the north-south transect there is a gradual decrease in the pH, going from the shore towards the reed vegetation. In the reed vegetation the pH rises again. Since the vegetation in the transect is rather uniform, the pH-differences must be ascribed to the influences of the shore and the reed habitat respectively.

In the east-west transect the same trend, if present, is far less well represented. The pH could not be measured in many spots because the water was below the surface. It was not possible to measure the pH in the very shallow stands without mixing the soil with the water above it. Since the processes going on in the soil are different from those in the water, a mixing of both is probably responsible for the pH-differences, measured in the same stand on the same date.

In the north-south transect there was between 5 and 10 cm of water throughout the whole area, and pH-measurements could be executed without disturbing the soil surface.

The few pH-measurements of the east-west transect show values that are lower than those of the north-south transect. The lower pH-values may indicate a habitat which is suitable for the character taxa of the Eleocharetum multicaulis. It was seen in the Isoeto-Lobelietum that the subassociation of *Eleocharis multicaulis* had a lower pH than any other subassociation of the association.

Why the vegetation in the two transects is so different, cannot be explained without further investigation. The influence of the ditch with enriched water might be greater on the vegetation of the north-south transect, but this is just a speculation.

V.4 Eleocharetum acicularis Koch 1926

V.4.1 Introduction

In 1911 BAUMANN described the vegetation of the „Bodensee" (Lake of Constance) in Switzerland, one of the communities mentioned by BAUMANN was called the „Heleocharetum (acicularis)" This community consists of the taxa *Eleocharis acicularis, Littorella uniflora, Ranunculus reptans, Myosotis rehsteineri* and *Scorpidium scorpioides*, and was found on the silty or sandy shore between the high and low water level

KOCH (1926), using the methods of the Zurich-Montpellier School, mentioned the Eleocharetum acicularis from another lake in Switzerland, it was represented by the association character taxon *Ranunculus reptans* and the alliance character taxa *Eleocharis acicularis* and *Littorella uniflora* He considered the association to be far better developed in the „Bodensee", where the character taxa *Deschampsia litoralis* var *rhenana, Galium palustre* var *humifusum, Saxifraga oppositifolia* ssp *amphibia* and *Statice purpurea* var *purpurea* were present, together with the taxa already mentioned by him

The Eleocharetum acicularis was mentioned by OLTMANNS (1927), JONS (1934), TUXEN (1937, 1955), BENNEMA et al (1943), PFEIFFER (1945), WESTHOFF et al (1946), LEBRUN et al (1949), BRAUN-BLANQUET & TUXEN (1952), TUXEN & OBERDORFER (1958), SCAMONI (1963), SCHWICKERATH (1963), PASSARGE (1964, as a „group of associations"), GEHU & WATTEZ (1965), SEGAL (1965, 1968), RUNGE (1966, 1969), WESTHOFF & DEN HELD (1969) and PIETSCH (1971 MS)

Most character taxa of the association, mentioned by BAUMANN (1911) and KOCH (1926) have a very restricted area, viz *Deschampsia rhenana, Saxifraga amphibia, Myosotis rehsteineri, Armeria purpurea* and *Galium palustre* var *humifusum* They are therefore lacking in the releves of the authors just cited

GADECEAU (1909) distinguished associations sensu WARMING (1896), i e plant communities characterized by one or more dominant species and a number of regular companions One of the associations, mentioned by GADECEAU, is called „Littorelletum", it consists of the dominant species *Littorella uniflora*, and of *Eleocharis acicularis, Echinodorus ranunculoides* fo *graminifolius, Elatine hexandra* and *E campylosperma*

MALCUIT (1928) described an „association of *Littorella uniflora* and *Eleocharis acicularis*", which is essentially the same as the Eleocharetum acicularis of the previously mentioned phytosociologists, except BAUMANN (1911) and KOCH (1926) The Littorello-Eleocharetum acicularis Malcuit 1929 is mentioned by MULLER-STOLL et al (1962), PIETSCH (1963), PHILIPPI (1969) and KRAUSCH (1969) *)

KLIKA (1935) described an *Eleocharis acicularis Littorella uniflora*-association, which he considered very similar to the association described by MALCUIT (1928) KLIKA's (1935) releves are different, however, by the presence of the species *Bulliardia aquatica, Illecebrum verticillatum* and *Myosotis caespitosa*, considered by KLIKA as character taxa of the alliance and the association In JILEK (1956) the same association is mentioned DUVIGNEAUD (1971) mentioned the Littorello-Eleocharitetum acicularis Chouard 1924

OBERDORFER (1957) designed a new name for the association from the „Bodensee", as described by BAUMANN (1911) and KOCH (1926), it was called the Deschampsietum rhenanae The *Eleocharis acicularis* association in the remaining area was called Littorello-Eleocharitetum Malc '29 *)

These two associations have been mentioned by MULLER & GORS (1960), LANG (1962, 1969), PIETSCH (1965a) and OBERDORFER et al (1967)

PIETSCH (1971 MS) accepts both associations, but he gives the name Eleocharetum acicularis sensu Koch '26, to the Deschampsietum rhenanae Oberd whereas the Littorello Eleocharitetum acicularis Malcuit keeps its name

KOCH (1926) described in fact two associations, from different regions, under one name OBERDORFER (1957) has split this complex association in two, the Deschampsietum rhenanae and the Littorello Eleocharitetum acicularis The rules of nomenclature prescribe, that the name of the original syntaxon has to be given to one of the new syntaxa, if splitting into units of equal rank takes place (MORAVEC 1968) Therefore, the name Littorello Eleocharitetum acicularis has to be replaced by Eleocharetum acicularis Koch 1926 em Oberdorfer 1957

So the name Deschampsietum rhenanae has to be preserved for the association found in the „Bodensee", and the name Eleocharetum acicularis Koch '26 for the *Eleocharis acicularis*-association found in other regions if belonging to the Littorelletea Since KOCH (1926) published two years before MALCUIT (1928), the name used by the first author has priority

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*) OBERDORFER and other authors refer to MALCUIT (1929) although a valid description of the given community dates from MALCUIT (1928)

The restriction „belonging to the Littorelletea" in the sentence before last is necessary, because *Eleocharis acicularis* is also found in other classes, especially in the Isoeto-Nanojuncetea: WENDELBERGER-ZELINKA (1952), PIGNATTI (1957), NEUHÄUSL (1959), HEJNÝ (1960), GÉHU (1961), ANT & DIEKJOBST (1967), PIETSCH & MÜLLER-STOLL (1968), POP (1968), PHILIPPI (1968), DIEKJOBST & ANT (1969).

SØRENSEN (1942) and HADAČ (1971) have mentioned the occurrence of the Eleocharetum acicularis islandicum from Iceland. This association differs from the more southern association by the presence of a number of arctic and subarctic species and other factors.

Eleocharis acicularis was noted in Eleocharetum multicaulis communities by GADECEAU (1909), CHOUARD (1925), ALLORGE & GAUME (1931) and LEMÉE (1937).

As far as the Littorelletea are concerned, the *Eleocharis acicularis* communities are classified into the Littorellion by most phytosociologists: KOCH (1926), MALCUIT (1928), JÖNS (1934), KLIKA (1935), TÜXEN (1937, 1955), SØRENSEN (1942), BENNEMA et al. (1943), PFEIFFER (1945), WESTHOFF et al. (1946), BRAUN-BLANQUET & TÜXEN (1952), OBERDORFER (1957), TÜXEN & OBERDORFER (1958), MÜLLER & GÖRS (1960), MÜLLER-STOLL et al. (1962), SCAMONI (1963), PIETSCH (1963), SCHWICKERATH (1963), LANG (1962, 1969), DEN HARTOG & SEGAL (1964), PASSARGE (1964), SEGAL (1965, 1968), IVIMEY-COOK & PROCTOR (1966), RUNGE (1966, 1969), OBERDORFER et al. (1967), PHILIPPI (1969) and WESTHOFF & DEN HELD (1969).

PIETSCH (1965, 1971 MS) and DUVIGNEAUD (1971, 1972) classified their *Eleocharis acicularis* communities into the Eleocharition acicularis, LEBRUN et al. (1949) in the Helodo-Sparganion and HADAČ (1971) into the Subularion aquaticae. LOUIS & LEBRUN (1942) considered *Eleocharis acicularis* a character taxon of the Isoëto-Littorelletea DIERSSEN (1972) of the Juncetea bulbosi.

Eleocharis acicularis communities in Scandinavia are mentioned among others by ALMQUIST (1929), VAARAMA (1938), STÅLBERG (1939) and ANDERSSON (1971); they have been studied with methods that are different from those used by the Zurich-Montpellier School.

V.4.2 The present relevés (table 15)

The 26 relevés which are published here and belong to this association were made by the present author in The Netherlands, France and Ireland, and by W Diemont and G Sissingh in The Netherlands

Four subunits can be distinguished within this association

I subassociation of *Echinodorus ranunculoides*

II subassociation of *Echinodorus repens*

III variant of *Myriophyllum alterniflorum*

IV impoverished variant

I subassociation of *Echinodorus ranunculoides* (relevés 1-9)

The floristic difference between this subassociation and the subassociation of *Echinodorus repens* is not great, apart from the fact that *E ranunculoides* is found only in the first subassociation, and *E repens* only in the second subassociation

Species that are present in both subassociations, but have a higher frequency in this subassociation, are *Apium inundatum*, *Glyceria fluitans*, *Galium palustre* and *Mentha aquatica*.

The presence of *Potamogeton polygonifolius* in the releves 1-4 is striking, since they were all made by W Diemont and G Sissingh, none of the recent relevés contains this species The phreatic level in most stands exceeded soil surface Only two water analyses could be executed, both showing a neutral pH, the water or the site of rel 5 is extremely poor in electrolytes, as appears from the electrical conductivity amounting to no more than 41 μS In the stand of rel 6 it was 149 μS The lime-content was low in both stands and probably also in the stands of releves 1-4, since they are derived from isolated sandy regions

In the Irish relevés the lime-content is probably higher, since the pools are situated on a calcareous soil

The Cl^- values, measured in rel 5 and rel 6 are very different, the value of 4 6 mg/l in rel 5 is very low, whereas 28 5 mg/l in rel 6 represents a normal value

In most stands a weak soil was found, no data are available from the releves 2 and 4 The French releves (5 and 6) are derived from a compact sandy soil, covered with a thin layer of mud in rel 6

II subassociation of *Echinodorus repens* (releves 10-17)

One relevé made by G Sissingh, has been classified into this subassociation, although G Sissingh never distinguished between *Echinodorus ranunculoides* and *E repens* KERN & REICHGELT

(1950) have mentioned the occurrence of *E repens* in the region where from which G Sissingh's releve is derived, whereas *E ranunculoides* did not occur there This makes the species referred to more likely to be *E repens* than *E ranunculoides*

Elatine hexandra and *Gnaphalium uliginosum* are among the species present in this subassociation, but absent in the former In all stands the phreatic level was found below surface, so no water analyses could be executed. Except in the stand of rel. 10 the soil was rather compact, consisting of sand covered with a thin layer of mud or organic matter (flood mark) or loamy sand

III variant of *Myriophyllum alterniflorum* (relevés 18-23)

This syntaxon could not be given a rank higher than variant, since all relevés are derived from the same site, a former loam-pit, in the municipality of Udenhout, in the province of North-Brabant

In the summer of 1970 there was a number of isolated pools, but in winter the whole site is flooded and no separate pools can be distinguished

The relatively great homotoneity of this part of the table has to be assigned to the fact that the relevés are derived from the same site

The variant is characterized floristically by the constant species *Eleocharis acicularis, Myriophyllum alterniflorum* and *Elodea nuttallii* The latter species is known from The Netherlands since 1941, and it is spreading rather quickly (Flora Neerlandica I, 1964) It was not observed in the pools in 1968, but in 1970 it completely filled all the small pools In 1972 the species could not be recovered again, however

Moreover, this variant differs from the two former subassociations by the almost complete absence of Phragmitetea- and ecotone species The variant has been found on loamy sand, and the phreatic level within the stands usually exceeded the surface, the greatest waterdepth being 40 cm

The pH close above soil surface was considerably lower than the pH of the water overlying it, differences of 2 pH-units and more were found' The water of the top-layer was found to be distinctly alkaline in almost all stands, the highest value was 9 95' The electrical conductivity measurements showed values between 142 and 206 μS in the top layer of the water, in the bottom layer it is probably higher, as is suggested by the measurement in the stand of rel 21 in the soil a value of 274 μS was measured, in the water overlying it only 206 μS

IV impoverished variant (relevés 24-26)

These three releves can not be classified into one of the former syntaxa since no differential taxa are present *Eleocharis acicularis* is the dominant species, in rel 24 codominant with *Elatine hexandra*

The releves are derived from sand and loamy sand

V.4.3 Synecology

Most releves in the present table are derived from a habitat that is enriched with nutrients in comparison with the habitat of associations such as the Isoeto-Lobelietum or the Eleocharetum multicaulis

Releve 5 is derived from a shallow part of a bay in a large lake, in deeper and less exposed parts a vegetation of *Phragmites australis, Typha* spec , *Nuphar lutea Iris pseudacorus* and *Juncus effusus* was found, which shows the eutrophic nature of the water VANDEN BERGHEN (1967) measured 8 mg Ca^{2+}l and 35 mg Cl^-/l in the same lake, whereas I found 1 8 and 28 5 mg/l respectively, BAUDRIMONT (1971) measured 22 mg Cl^-/l VANDEN BERGHEN (1967) published a number of releves belonging to the Eleocharetum multicaulis, they are probably derived from the shores and from the centre of the lake, where the is a great influence from the oligotrophic surroundings

The Irish releves (7-9) are all derived from a calcareous soil, the lime-content in the stand itself was not measured, but measurements at various spots in the lake of rel 8 and 9 showed values of 42, 29 and 40 mg Ca^{2+}/l

BRAUN-BLANQUET & TUXEN (1952) mention the occurrence of the association in Ireland on calcareous soils with a coarse or a fine structure The association is found in The Burren, Co Clare (Ireland), on calcareous, humous mud, that is inundated frequently (IVIMEY-COOK & PROCTOR 1966) It is striking that all Irish releves are derived from calcareous soils, and that calcareous substrates of Eleocharetum acicularis are hardly mentioned from other parts of Europe

KOCH (1926) calls the association calciphilous but he does not mention calcareous soils in describing the habitat of the association In PIETSCH (1963) one releve is published that is derived from a calcareous soil

Releves 11, 13 and 14 are derived from the shores of a lake that contains mesotrophic water, they have run dry recently In the site of rel 11 the soil was covered with a foamy flood mark, and in the relevés 13 and 14 birds were frequent visitors of the stands Both factors are supposed to have caused some eutrophication

Most of the remaining releves are derived from the loam-pit near Udenhout, mentioned before in which very high pH-values were measured This may be seen as an indication of mesotrophic or eutrophic conditions

Rel 17, which cannot properly be considered a representative of the Eleocharetum acicularis, shows a eutrophic vegetation, in which *Eleocharis acicularis* is present The pool of rel 12 contains enriched water, as can be concluded from the pH-values (7 9-8 3) and the occurrence of species such as *Glyceria maxima, Sagittaria sagittifolia, Iris pseudacorus* and *Phragmites australis* In the pool of rel 26 a comparable situation was found

The releves made by W Diemont and G Sissingh (1-4, 10), all but one indicate somewhat enriched habitats the site of rel 1 adjoins a Caricion curto-nigrae community (Parvocaricetea), this alliance (order) consists of communities of mesotrophic to eutrophic soils In rel 3 the occurrence of a *Phragmites australis* belt around the stand is mentioned, as well as recreational activities, including swimming The vegetation of rel 10 is surrounded by species „such as *Carex rostrata* and *Alisma plantago-aquatica*", characteristic of meso-eutrophic habitats Rel 4 was made in a little ditch in a Caricetum curto-echinatae vegetation, which can be considered a meso-trophilic vegetation

The presence of *Potamogeton polygonifolius* in these releves shows that there is only slight eutrophication, since this species is mainly found in oligotrophic habitats

The stand of rel 5 represents an exceptional habitat, when the extremely low values for the electrical conductivity and the Cl^{-} content are taken into account

The association was found usually on a mud or clay soil, of which sand formed an important ingredient Pure sand or a layer of organic matter were found only rarely The water level fluctuates throughout the year, most stands run dry in summer

Most phytosociologists mention the amphibious nature of the association, most stands run dry during part of the year GADECEAU (1909), BAUMANN (1911), CHOUARD (1925), KOCH (1926), MALCUIT (1928),

JONS (1934), KLIKA (1935), TUXEN (1937), LEMEE (1937), PFEIFFER (1945), LEBRUN et al (1949), OBERDORFER (1957), MULLER & GORS (1960), MULLER-STOLL et al (1962), PASSARGE (1964), GEHU & WATTEZ (1965), RUNGE (1966, 1969), WATTEZ (1968), WESTHOFF & DEN HELD (1969) and DUVIGNEAUD (1971)

The trophic level of the water is mentioned by several phytosociologists, it varies between oligotrophic and eutrophic An oligotrophic habitat is mentioned by TUXEN (1937), LEMÉE (1937), PFEIFFER (1945), RUNGE (1966, 1969), WATTEZ (1968), and KRAUSCH (1969)

DUVIGNEAUD (1971) measured an electrical conductivity of 58 8-121,3 μS (at 10° C) in the stands, ANDERSSON (1971), who did not qualify the trophic level in his stands, measured an electrical conductivity of 96-127 μS, a pH of 6 2-8 2, and a Cl^- content of 12-19 mg/l, in the lake from which the *Eleocharis acicularis*-stands are derived LEMEE (1937) measured a pH of 5 0-6 0

An enriched habitat, in comparison to most Littorelletea-associations, is mentioned by JESCHKE (1959) and WESTHOFF & DEN HELD (1969) Richness in N (nitrogen) is mentioned by MALCUIT (1928) and LEBRUN et al (1949) The first author holds grazing responsible for the N-richness

Grazing is also mentioned by MARISTO (1935), GEHU & WATTEZ (1965) and WATTEZ (1968)

The association was found on a variety of soils on sand by CHOUARD (1925), JONS (1934), LEMÉE (1937), TUXEN (1937), PFEIFFER (1945), MULLER & GORS (1960), MULLER-STOLL et al (1962), GEHU & WATTEZ (1965), WATTEZ (1968) and KRAUSCH (1969), on sand or gravel by PHILIPPI (1969), on sand or silt or sandy silt by GADECEAU (1909), BAUMANN (1911), KOCH (1926), MALCUIT (1928), KLIKA (1935), LEBRUN et al (1949), JILEK (1956), OBERDORFER (1957) and RUNGE (1966, 1969), on sand, silt or clay by WESTHOFF & DEN HELD (1969), on clay or loam by ANDERSSON (1971), on schists by DUVIGNEAUD (1971)

BENNEMA et al (1943) do not give many details about the ecology of the Eleocharetum acicularis, but they point out the floristic similarity with the Eleocharetum multicaulis, and they expect therefore a similar synecology of both associations The authors further remark that the Eleocharetum acicularis usually occurs in drier sites than the subassociation of *Potamogeton polygonifolius*, and in more enriched sites than the subassociation of *Deschampsia setacea*, both subassociations of the Eleocharetum multicaulis

DUVIGNEAUD (1971) observed that almost all stands of Eleocharetum acicularis which were studied by him, are situated on the southern shores of lakes, and he therefore concludes that the majority of the component species are heliophilic This conclusion only makes sense if parts of the lakes get shaded, in some lakes woods grow close to the shore and cause shading

MALCUIT (1928) described four facies of the association, they are determined by the nature of the soil (sand or silt), the position on the shore (wet or dry) and by grazing (supply of nitrogen)

MARISTO (1935) described the influence of grazing on the vegetation of the shore of a lake, the community with *Eleocharis acicularis* appears to be best developed in a grazed site with a water depth of 50 cm.

PIETSCH (1963) mentioned the association from a great variety of habitats water filled peat-cuttings, abandoned sand- and gravel-pits, ditches, bung-holes, shores of fish-ponds and mine-pits, and inundation-belts of the shores of rivers and beaches When the soil desiccates, *Eleocharis acicularis* dies off after flourishing, and the association becomes infiltrated with Nanocyperion-species

In Iceland the Eleocharetum acicularis islandicum Sørensen '42 is found on „flags", oblong humid sheets of loam, strongly influenced by frost phenomena (SØRENSEN 1942)

V.4.4 Synchorology

The Eleocharetum acicularis has an almost continuous distribution from Denmark (IVERSEN 1929) via Schleswig-Holstein (JONS 1934, SAUER 1937), north western Germany (TUXEN 1937, 1955, PFEIFFER 1945, SCHWICKERATH 1963 and RUNGE 1966, 1969), and The Netherlands (BENNEMA et al 1943, SEGAL 1965, WESTHOFF & DEN HELD 1969) to Belgium (LEBRUN et al 1949, DUVIGNEAUD 1971)

The association was mentioned further south, in France, by GÉHU & WATTEZ (1965) and WATTEZ (1968) from Pas-de-Calais et Somme, by GADECEAU (1909) from the neighbourhood of Nantes, by LEMEE (1937) from Le Perche, and by CHOUARD (1925) from Confolentais, west of Limoges The present investigation has yielded relevés from eastern Brittany and Les Landes TUXEN & OBERDORFER (1958) mention a fragmentary stand of the association from a southern offshoot of the Pyrenees

Going from Belgium into the south east direction, the association is represented in the Vosges (MALCUIT 1928), in south western Germany (OLTMANNS 1927, OBERDORFER 1957, MULLER & GORS 1960 and PHILIPPI 1969), and in the „Bodensee", on the border between Germany and Switzerland (BAUMANN 1911, KOCH 1926, OBERDORFER 1957, MÜLLER & GÖRS 1960, LANG 1962, 1969). The Deschampsietum rhenanae, which has been split off from the Eleocharetum acicularis by OBERDORFER (1957) is found only in the „Bodensee".

East from the Dutch and the western part of the German area the association is found in Mecklenburg, north of Berlin (JESCHKE 1959, SCAMONI 1963); in the Lausitz (MÜLLER-STOLL et al. 1962, PIETSCH 1963, KRAUSCH 1969), and in Czechoslovakia (KLIKA 1935, JILEK 1956).

WEST (1910) mentions Eleocharetum acicularis communities from the southern part of Scotland. In Ireland the association is known from the western part by BRAUN-BLANQUET & TÜXEN (1952) and IVIMEY-COOK & PROCTOR (1966); two relevés belonging to the association were made by the present author in central Ireland.

In Scandinavia the association appears in a somewhat different floristic composition, caused mainly by the presence of *Subularia aquatica* and *Ranunculus reptans*; this „northern" Eleocharetum acicularis has been reported from Sweden by ALMQUIST (1929), STÅLBERG (1939) and ANDERSSON (1971); from Finland by MARISTO (1935) and VAARAMA (1938); it probably occurs in Norway as well (BRAARUD 1932).

The Eleocharteum acicularis islandicum is reported from Iceland by SØRENSEN (1942) and HADAC (1971).

V.4.5 Discussion

The Eleocharetum acicularis is a vaguely delimited association, since the character taxon, *Eleocharis acicularis*, has a great ecological amplitude. It is found, therefore, in a great variety of plant communities, many of them not belonging to the Littorelletea.

Eleocharis acicularis is observed frequently in Nanocyperion communities, especially in the Eleocharetum soloniensis (= Eleocharetum ovatae), where it is accompanied by *Eleocharis soloniensis* (= *E. ovata*), *Limosella aquatica* and other species. This association is mentioned by many phytosociologists from many regions: WESTHOFF & DEN HELD (1969) and WEEDA (1970) in The Netherlands, ANT & DIEKJOBST (1967) in Sauerland in western Germany, SCHWICKERATH (1963) in the Eifel, KOCH (1926) and PHILIPPI (1968) in south western Germany, PIETSCH (1963) in the Lausitz, PIETSCH & MÜLLER-STOLL (1968) in east central Europe, KOCH (1926) in southern Switzerland, PIGNATTI (1957) in Italy, WENDELBERGER-ZELINKA

(1952) in Austria, NEUHÄUSL (1959) and HEJNY (1960) in Czechoslovakia, GÉHU (1961) in northern France, and WRIGHT & BENT (1969) in New-Mexico, U.S.A.

In Roumania a vegetation of the Eleocharetum acicularis Horvatic is described by POP (1968), which contains many Nanocyperion-elements. Compare also HORVATIC (1931). *Eleocharis acicularis* is also found in Bidentalia communities (ALLORGE 1922).

In most of the above cited cases the Nanocyperion vegetation was observed in regions where Littorelletalia communities are absent or poorly represented, since they are situated too far east or south-east. But in some regions both the Eleocharetum acicularis and the Eleocharetum soloniensis occur, for instance in The Netherlands. The associations are found in different habitats. The habitat of the Eleocharetum acicularis is rendered already; the Eleocharetum soloniensis is found on open spots on a sand or clay soil on the river forelands (WESTHOFF & DEN HELD 1969).

An example of the Eleocharetum soloniensis is given the following in relevé. It was made in an abandoned branch (former river bed) of the river Waal, near the village of Gendt in the province of Guelderland. The soil consists of mud, and is heavily treaded by horses and cattle.

water depth (cm)	0-5
cover %	50
number of species	15
character taxon of the association	
Limosella aquatica	2a.2
differential taxon	
Eleocharis acicularis	3.3
character taxa of other syntaxa	
a. Phragmitetea	
Myosotis scorpioides	1.1
Rumex hydrolapathum	r.1
b. Glycerio-Sparganion	
Veronica catenata	2a.2
Glyceria fluitans	1
Hippuris vulgaris	( )

c Oenanthion	
Oenanthe aquatica	1 1
Alisma lanceolata	1 1
Rorippa amphibia	( )
d Potametea	
Callitriche spec	+ 2
Ranunculus aquatilis	r
Nymphoides peltata	( )
Polygonum amphibium fo *natans*	( )
e character taxa and differentials of Agropyro-Rumicion crispi	
Agrostis stolonifera	+
Juncus articulatus	+ 1
Trifolium fragiferum	( )
Lysimachia nummularia	( )
f Bidentetalia	
Rorippa islandica	+ 1
remaining species	
Mentha aquatica	r
Equisetum palustre	+ 1

Most species in the relevé are derived from the Phragmitetea of which two alliances are represented. The first one is the Glycerio-Sparganion, which contains communities from the shores of narrow fresh-waters The current is usually horizontal, or ocassionally vertical, frequently stands run dry in summer The communities are found on mineral soil, especially sand and loam This alliance is represented by the alliance character taxa *Glyceria fluitans* and *Veronica catenata*, whereas the latter species and *Hippuris vulgaris* indicate the Eleocharito-Hippuridetum This association is often found on the border area between Holocene and Pleistocene

Oenanthe aquatica, Alisma lanceolata and *Rorippa amphibia* represent the Oenanthion, an alliance with communities of shallow, usually eutrophic water on loam or clay, sometimes on a sandy soil, there is a fluctuating water level The alliance is found usually in former river beds, that become flown through now and then

Moreover, the Phragmitetea are presented by two character taxa of the class, viz *Rumex hydrolapathum* and *Myosotis scorpioides*

Callitriche spec and *Ranunculus aquatilis* are character taxa of the Potametea, which indicate meso-eutrophic fresh waters, other character taxa of this class, occurring outside the sample plot in deeper water, are *Nymphoides peltata* and *Polygonum amphibium* fo *natans*

The ecotone alliance Agropyro-Rumicion crispi is represented by *Agrostis stolonifera, Juncus articulatus* and, outside the sample plot, by *Trifolium fragiferum* and *Lysimachia nummularia*

Rorippa islandica indicates nitrophilous communities of shallow water with a fluctuating level (Bidentetalia)

The occurrence of *Limosella aquatica* in the relevé deserves special attention In The Netherlands, this species is rare in the Fluviatile district and very rare elsewhere It is mainly found in open spots on the shores of rivers Until about 1940 the area of this species, just like that of *Elatine hydropiper* was extending much farther west, down to the fresh water tidal delta (WESTHOFF et al 1971, p 206) The water pollution alone can not be held responsible for the driving back of the species, since the large rivers are strongly polluted in the eastern part of The Netherlands as well

Eleocharis acicularis is present in the tables or lists of the Eleocharetum soloniensis published by KOCH (1926), OBERDORFER (1957) and SCHWICKERATH (1963) They all consider *Eleocharis acicularis* a companion species of the Eleocharetum soloniensis, and a character taxon of the Eleocharetum acicularis WESTHOFF & DEN HELD (1969) consider *Eleocharis acicularis* a differential taxon of the Eleocharetum soloniensis within the Nanocyperion PHILIPPI (1968) mentioned the occurrence of *Eleocharis acicularis* in various associations of the Cyperetalia fuscis The species had a low presence degree and was considered by PHILIPPI (1968) a companion species

In PIETSCH (1963) the situation is more complicated The author considers *Eleocharis acicularis* a character taxon of the Eleocharetum acicularis within the Littorelletea The species is also present, however, in three Nanocyperion associations It is most frequent in the Eleocharito-Caricetum cyperoides Klika 1935 em Pietsch 1961, the presence degree of *Eleocharis acicularis* is V in almost all subunits, and the combined estimation usually does not exceed 3 In the variant of *Alisma plantago-aquatica* of the typical subassociation, however, *Eleocharis acicularis* is represented with a combined estimation of 4 or 5 PIETSCH (1963) notes that in this variant the character taxa of alliance and order are poorly represented Three character taxa of the Phragmitetea are present with a presence degree of IV or V

Therefore this variant cannot be considered a typical representative of the association.

Apart from the presence in the Eleocharito-Caricetum cyperoides, PIETSCH (1963) also mentioned the presence of *Eleocharis acicularis* in the Cypero-Limoselletum (Oberd.' 57) Korneck '60 and in the Centunculo-Anthoceretum punctati (Kock '26) Moor '36, but with a low combined estimation and a low presence degree.

In the Eleocharetum acicularis PIETSCH (1963) observed *Eleocharis acicularis* with a presence degree of V, and a combined estimation of (2)3-5 in the typical variant and the variant of *Sparganium angustifolium*, and a combined estimation of +–3 in various facies.

These data show that *Eleocharis acicularis* belongs to the Littorelletea rather than to the Isoeto-Nanojuncetea. It has therefore to be considered a character taxon of the Eleocharetum acicularis and a differential taxon of the Eleocharetum soloniensis.

The relevé published in V.4.5 shows that *Eleocharis acicularis* can occur with a high combined estimation in an association that does not belong to the Littorelletea. The relevé in question is classified into the Eleocharetum soloniensis, an association that belongs to the Nanocyperion; a number of Phragmitetea taxa is present with a low cover degree.

Such communities are not uncommon in the Fluviatile District in The Netherlands.

This behaviour of *Eleocharis acicularis* causes problems as for the syntaxonomical position of the species. It cannot be considered a character taxon of two different associations in the same region. TÜXEN (1952) tried to solve such problems by considering this sort of vegetation as a complex of different communities. He invented the term „Teppichgesellschaften" (= carpet communities), indicating a vegetation which uses the underlying vegetation as its substrate. The word „Teppich" (carpet) suggests a closed vegetation cover; the vegetation usually has an open structure in practice, however. Therefore the term „warp and woof communities" fits the real situation better. The term „woof community" was first mentioned by E. VAN DER MAAREL in WESTHOFF & DEN HELD (1969).

The Eleocharetum acicularis has to be considered the warp community, whereas the Eleocharetum soloniensis represents the woof community.

The first mentioned association is present permanently; when the soil runs dry, an association of short living summer therophytes can develop on it. This complicated structure of the vegetation gives problems in choosing the sample plots, since mixtures of both communities would easily be included. If one chooses the sample plots carefully, however, one should succeed in separating both communities more or less

This theory implies that *Eleocharis acicularis* is expected to have a higher combined estimation and presence degree in the Eleocharetum acicularis than in the Eleocharetum soloniensis,it is affirmed in PIETSCH (1963) *Eleocharis acicularis* is not all mentioned in the Eleocharetum soloniensis by KLIKA (1935), DIEMONT, SISSINGH & WESTHOFF (1940) and RUNGE (1966, 1969)

The combination of *Eleocharis acicularis* and *Sparganium angustifolium* in PIETSCH (1963) deserves special attention In western Europe this combination is very uncommon, since *Eleocharis acicularis* is a meso-eutrophilic species, whereas *Sparganium angustifolium* is oligotrophilic This combination was observed once in The Netherlands by G Sissingh, who also noted *Pilularia globulifera* in the same stand (rel 1, table 14)

The Eleocharetum acicularis, probably more than the Pilularietum globuliferae, needs an enriched habitat As we have seen at the Pilularietum, this implies the competition with tall species with a high primary production Therefore the Eleocharetum acicularis is found usually as a pioneer-stage in a vegetation succession, or in sites where the tall species are impeded by treading, extreme water level fluctuations, grazing or a combination of these factors

In fish-ponds the tall species are impeded, because the ponds are drained every couple of years (HEJNY 1969, PIETSCH & MULLER-STOLL et al 1962, PIETSCH 1971 MS) On the Icelandic „flags" the climate is so severe, that only some species (among which *Eleocharis acicularis*) can stand it (SØRENSEN 1942, HADAČ 1971), all of them little species

Grazing is in important factor in keeping tall species under control (WATTEZ 1968)

In the rice-fields, where *Eleocharis acicularis* occurs as a weed, only species which are adapted to the agricultural methods used, can survive (PIGNATTI 1957, HEJNY 1960)

The impression is got that the Eleocharetum acicularis in Ireland only occurs on calcareous soils, since all releves made by the present author, BRAUN-BLANQUET & TUXEN (1952) and IVIMEY-COOK & PROCTOR (1966) are derived from calcareous soils

PRAEGER (1934) however, mentions the occurrence of *Eleocharis acicularis* from sites where nor calcareous soil is present

The pH-differences between the water in the soil and the water above it, are striking in the loam-pits of releves 15, 16, 18-25 It is not known which habitat (soil or water) is most important to the species of the Eleocharetum acicularis, their roots are attached in the soil but the remaining part of the plants is in the water Since the plants are not in the water the entire year, whereas their roots are always in the soil, the soil factor might be more important In that case the circumneutral pH measured in the soil of the Eleocharetum acicularis stands is not exceptional

Most pH-mentions in literature refer to the open water of the lakes and pools, the pH of the water in the soil is usually not mentioned It is therefore impossible to know whether pH-differences between the water in the soil and above it are commonly of the same magnitude as in the present measurements

TUXEN (1937) and PFEIFFER (1945) describe the habitat of the Eleocharetum acicularis as follow „on periodically inundated, sandy shores of oligotrophic pools and lakes" The subassociation of *Potamogeton polygonifolius* of the Eleocharetum multicaulis is found „in very shallow, oligotrophic pools with a strongly fluctuating water level", whereas the subassociation of *Agrostis canina* of the same association is found „on the shores of shallow, oligotrophic pools with a fluctuating water level" It is not clear what are the differences In all three syntaxa the soil runs dry during a part of the year, and all habitats have a fluctuating water level The water is oligotrophic in all three cases, but data about the soil are only given for the Eleocharetum acicularis

The Scandinavian *Eleocharis acicularis* communities have a floristic composition that differs from the „southern" Eleocharetum acicularis mainly by the presence of *Subularia aquatica* and *Ranunculus reptans* The latter species, however, is also found in the Swiss Eleocharetum acicularis The eroding influence of the ice on the shores of the Scandinavian lakes seems to be the master factor in determining what species can grow there

ANT & DIEKJOBST (1967) have published a table of a community, with *Eleocharis acicularis* as the dominant species They have classified their releves into the Eleocharetum acicularis Koch '26, subassociation of *Juncus bufonius* *Juncus bufonius*, however, is found in one releve only (cover-abundance +), and no species representing the Littorelletea are present The releves should better be regarded as a sociation of *Eleocharis acicularis*, belonging to the Plantaginetalia (*Plantago intermedia, Agrostis stolonifera, Poa annua, Polygonum rurivagum* and *Potentilla anserina*), and with elements of Nanocyperion and Bidentalia

V.5 Samolo-Littorelletum Westhoff 1943

V.5.1 Introduction

Two publications on this association appeared in 1943 In WESTHOFF (1943), in a printed publication, the name of the association was given, its character taxa (*Juncus articulatus* var *littoralis* and *Samolus valerandi*), and its plant geographically differential taxa (*Carex serotina* ssp *pulchella, Juncus anceps* var *atricapillus* and *Carex trinervis*) No releves were published, nor was the syntaxonomical position of the association mentioned Again in 1943 BENNEMA et al (1943) published this association Eight relevés were added and the association was classified into the Littorellion This mimeographed publication had a limited distribution, however, and it cannot be accepted as an effective publication according to the rules of nomenclature (MORAVEC 1968) These eight releves are republished in this work
In WESTHOFF et al (1946) the association was mentioned again, the former character taxa and *Ranunculus baudotii* were seen as differential taxa, whereas character taxa were absent In WESTHOFF (1947) *Samolus valerandi* is considered a preferent character taxon of the association, there are eight geographically differential taxa, o a *Carex serotina* ssp *pulchella, Juncus anceps* var *atricapillus* and *Carex trinervis* Both publications of WESTHOFF were without relevés
According to MORAVEC (1968) the association has not been effectively or validly published in any of these four publications
The description of the association as given by WESTHOFF (1943) gives a sufficiently diagnosis, however, especially since the occurrence of *Littorella uniflora* and *Echinodorus ranunculoides* in the association is mentioned Later publications have only added detail information, at least about the floristic composition Therefore the name of the association should be Samolo-Littorelletum Westhoff 1943

The association has also been mentioned by TUXEN (1955), MULLER & GORS (1960), MULLER-STOLL et al (1962), DEN HARTOG & SEGAL (1964), SEGAL (1965), PIETSCH (1965a), RUNGE (1966) and WESTHOFF & DEN HELD (1969)
VANDEN BERGHEN (1964) described a local variant of the association in south western France IVIMEY COOK & PROCTOR (1966) published a table of the „*Littorella uniflora– Baldellia (=Echinodorus) ranunculoides* association", which is identical to the Samolo-Littorelletum, and the French

releves published by WATTEZ (1968) under the name of Littorelletum lacustris can also be seen as representatives of that association The Littorelleto-Echinodoretum published by TUXEN & PREISING (1942) should be considered as a fragment of the Samolo-Littorelletum, according to BENNEMA et al (1943) PASSARGE (1964) mentioned an Echinodoretum ranunculoides, which he considered an impoverished example of the Littorello-Echinodoretum Tx et Prsg (42) and synonymous with the Samolo-Littorelletum Westh 43

The association appears to be bound to coastal regions (WESTHOFF 1947) Some similar Littorelletea communities found near the coast can be considered fragmentary coena, closely related to the Samolo-Littorelletum, but in variance by the lack of some or all of the differential taxa They have been mentioned by BRAUN-BLANQUET & DE LEEUW (1936), by ALBERTSON (1950) under the name *Littorella uniflora*-consociation, by FRODE (1958) under the name *Littorella uniflora Helosciadium* (=*Apium*) *inundatum* community, by Jeschke (1962) under the name *Apium inundatum Littorella uniflora*-association, and by GEHU (1964, classified into the Littorellion) OBERDORFER et al (1967) and PIETSCH (1971 MS) have mentioned 2 Littorelletalia-communities which are bound to the coast the Apio-Littorelletum Frode and the Littorello-Echinodoretum Tx et Prsg 1942, which they consider synonymous with the Samolo-Littorelletum Westh 47

Most phytosociologists have classified the association into the Littorellion BENNEMA et al (1943), WESTHOFF et al (1946), WESTHOFF (1947), TUXEN (1955), MULLER-STOLL et al (1962), VANDEN BERGHEN (1964), PASSARGE (1964), DEN HARTOG & SEGAL (1964), SEGAL (1965), RUNGE (1966), OBERDORFER et al (1967), WATTEZ (1968) and WESTHOFF & DEN HELD (1969) PIETSCH (1965, 1971 MS) classified the Samolo-Littorelletum and the Apio-Littorelletum into the Eleocharition acicularis

V.5.2 The present relevés

table 16

The releves made in different countries (The Netherlands, France and Ireland) have been arranged into one table, in order to allow an easy comparison

Two differential taxa of the association occurred in the releves of all three countries *Samolus valerandi* and *Potamogeton gramineus*, whereas two other differentials, viz *Carex trinervis* and *Salix repens* ssp *argentea*, were found in the Dutch and French releves only

In the Netherlands, *Carex serotina* ssp *pulchella* (= *C scandinavica* E W Davies) is a geographically differential taxon It is not known from Ireland and France (CLAPHAM, TUTIN & WARBURG 1962), *Carex serotina* in our material from these countries is considered to be *C serotina* ssp *serotina* Moreover, *Juncus alpino-articulatus* ssp *atricapillus* is mentioned as a geographically differential taxon of the association by WESTHOFF (1947), it has not been observed in the releves of the present author

Most companion taxa did not occur in the releves of all three countries, but only in two or one of them, they have been arranged in that order

Mentha aquatica, *Hydrocotyle vulgaris* and *Eleocharis palustris* ssp *palustris* are the only companions, present in the releves of all countries, although in Ireland the presence degree was lower than in the other countries

V.5.3 Synecology

The measurements show water with a pH between 7 and 8, and an electrical conductivity between 250 and 500 μS An exception is formed by the water of rel 18 where an electrical conductivity of 3700 μS was measured and a Cl^- content of 1300 mg/l

This lake receives seawater in one corner, which was marked by the occurrence of seaweeds

In the stands of most Dutch releves, derived from the island of Terschelling, no pH-and other measurements were done, since the water was below surface In the study of DENNERT (1971) it is shown that the water of the pool of rel 3 is poorer in electrolytes and more acid than that of most other pools found on the island (Terschelling), in the pool an electrical conductivity of 200 220 μS was measured and a pH of 4 8 7 2 This particular pool, the Van Hunenplak, was dug in 1950 on a rather isolated, not frequently visited, spot The pool is situated too far from the sea to become enriched in nutrients by sea-winds, moreover, the sand is very poor in lime The habitat is developing into oligotrophic direction

The highest measured Ca^{2+} content was found in The Netherlands on the island of Terschelling 57 mg/l DENNERT (1971) has noted 4 8 mg Ca^{2+}/l for the pool of rel 3

In the Irish stands only two measurements could be done, since water was below surface mostly, the Ca^{2+} content of 18 and 32 mg/l was not very high, considering that the relevés are derived from a region of carboniferous limestone.

These Ca^{2+} values are high in comparison with the inland water in which other Littorelletalia associations are found, such as the Isoeto-Lobelietum and the Eleocharetum multicaulis; in Scotland and France the Ca^{2+} content appeared to be less than 5 mg/l, in Ireland even less than 2 mg/l. In The Netherlands values between 5 and 10 mg/l were found regularly. The pool of rel. 3 is, for Ca^{2+} at least, comparable with these waters; values of 4-8 mg/l were found (DENNERT 1971).

The Cl^- value of 1300 mg/l found in the stand of rel. 18 is exceptional high, even for the Samolo-Littorelletum. The next highest value of 80 mg/l was found in The Netherlands. DENNERT (1971) found about 60 mg/l in the pool of rel. 3.

In the Scottish and Dutch waters, in which other Littorelletalia associations occurred, the Cl-values were less than 15 mg/l and less than 20 mg/l respectively. The values of 60 and 80 mg/l, measured in the Samolo-Litterelletum-pools in The Netherlands, were distinctly higher.

In France and in Ireland almost all investigated waters were situated comparably close to the sea. The influence of the sea spray was seen in the chemical composition of the water found in the lakes and pools: the Cl^- content of the waters with and without Samolo-Littorelletum communities was hardly different. In France the values were 38 and 47 mg Cl^-/l in the pools with, and 16-40 mg/l in the pools without Samolo-Littorelletum communities; in Ireland these values were 12 and 30 mg/l, and 14-40 mg/l respectively.

So the Samolo-Litorelletum requires a relatively high Cl^- and a relatively high Ca^{2+} content, compared to the inland waters with other Littorelletalia-associations.

IVIMEY-COOK & PROCTOR (1966) characterized the habitat of the association as „shallow pools or bays with quiet water and a bottom covered with marl of variable thickness."

WATTEZ (1968) measured about 60 mg Ca^{2+}/l, a pH between 7.5 and 8.5, and an electrical conductivity between 350 and 500 μS; the values from the same pool for the same factors, measured in the present study are 14 mg/l, 7.3, and 316 μS respectively. These differences might be ascribed to the fact that the measurements took place at different times (1965 and 1969) and perhaps on different spots. Some leaching could have taken place in that time, deminishing the amounts of Ca^{2+} and Cl^- and other ions.

BENNEMA et al. (1943) mentioned the occurrence of the association in

„oligo-halinic to fresh dune waters"; WESTHOFF et al. (1946) in „oligo-mesohalinic, calcareous, but otherwise oligotrophic water of shallow, clear, dune waters with a strongly fluctuating water level".
WESTHOFF (1947) mentioned the association to be observed in water „rather poor in lime", which presents a more restricted amplitude, however, than was found by the present author and other investigators.

V.5.4 Synchorology

The association has an atlantic distribution, since most of its differential taxa are bound to the sea coast of western Europa. Up till now the association has been found in the west Frisian islands (WESTHOFF 1947), dune waters in western France, a lake in south western France (VANDEN BERGHEN 1964) and in western Ireland, mainly in Co.Clare and Co.Galway. WESTHOFF & DEN HELD (1969) mention the association in Co.Clare and Co.Mayo, in western Ireland.

V.5.5 Discussion

Although MÜLLER & GÖRS (1960) have published the Samolo-Littorelletum relevés which belong to the manuscript of BENNEMA et al. (1943), this publication does not provide a full idea of the association, as MÜLLER & GÖRS (1960) omitted the companious and some of the differential taxa, 18 alltogether. Therefore, the complete relevés in question are rendered in table 17.
Two phases have been distinguished: a phase with *Scirpus maritimus* in relatively young dune slacks with 90-200 mg Cl^{-}/l, and a phase with *Carex trinervis* in older dune slacks with less than 90 mg Cl^{-}/l (WESTHOFF 1947).
A comparison of the relevés from table 17 with the Dutch relevés from the present author (table 16) shows that the phase with *Scirpus maritimus* is lacking in the latter; all recent Dutch relevés can be classified into the phase with *Carex trinervis*.
The similarity of both groups of relevés is great; the only real difference is the presence of *Juncus articulatus* var. *littoralis* in the older relevés, whereas it is absent in the recent relevés. The French relevés are also comparable with the phase with *Carex trinervis*, althought *Potamogeton gramineus*, *Juncus articulatus*, *Agrostis stolonifera*, *Teucrium scordium* and *Carum verticillatum*

distinguish them from the Dutch releves The latter two species are extremely rare in The Netherlands, *Teucrium scordium* occurs along the coast, *Carum verticillatum* is known from one inland locality

The Irish releves are different, *Carex trinervis* and *Salix repens* ssp *argentea* are lacking, whereas on the other hand *Potamogeton gramineus* and *Juncus articulatus* are very frequent *Carex trinervis* is not known from Ireland (CLAPHAM, TUTIN & WARBURG 1962) Previously published data on the Irish Samolo-Littorelletum are found in IVIMEY-COOK & PROCTOR (1966) their relevés of the *Littorella uniflora-Baldellia ranunculoides* association show practically no difference with the Irish relevés published here This is not surprising, since they are all derived from the same region in Ireland, The Burren

Another great similarity exists between the present French relevés and the relevés published by WATTEZ (1968) as Littorelletum lacustris His releves and relevés 8,9,11,12,14 and 15 of table 16 been made in the same dune slacks

In WATTEZ's table *Potamogeton natans* is a constant species,whereas in the present French relevés only *Potamogeton gramineus* was found It is unlikely that there were two different species in the dune slacks, because the releves have been made with only a few years interval, an incorrect identification might be responsible

GEHU (1964) published a fragment of the Samolo-Littorelletum from the same site as releves 10,13 and 16 of table 16

According to VANDEN BERGHEN (1964) the Samolo-Littorelletum occurs on the shores of the „Lac du Hourtin" in south western France The association is richer in species than in The Netherlands, especially by *Juncus heterophyllus, Scirpus americanus* and *Chara fragifera* (VANDEN BERGHEN 1964), this can be seen in 32 relevés accompanying the text The sample plots appear to be very large 70 m^2 on the average, whereas 1-4 m^2 is sufficient for communities like the Samolo-Littorelletum This may explain some of the differences found between the results obtained by VANDEN BERGHEN and other phytosociologists It is for instance striking that *Molinia caerulea* is a constant species in the Samolo-Littorelletum studied by VANDEN BERGHEN (1964) *Eleocharis multicaulis* and *Hypericum elodes* are also rather frequent It is possible that neighbouring communities are included, because of the large sample plots

MULLER-STOLL et al (1962) showed a relevé from Brandenburg in E Germany which they classified into the Samolo-Littorelletum, *Littorella uniflora* was lacking, but *Eleocharis acicularis* was present This is the only

mention of the occurrence of the latter species in the Samolo-Littorelletum
As fragments of the association should be considered the plant communities mentioned by BRAUN-BLANQUET & DE LEEUW (1936), FRODE (1958) and JESCHKE (1962), named as *Littorella uniflora-Helosciadium* (=*Apium*) *inundatum*-Gesellschaft by the second author

V.6 Sparganietum minimi (Schaaf 1925)

V.6.1 Introduction

SCHAAF (1925) first described the Sparganietum minimi, he considered *Sparganium minimum* as the „guiding species", and species such as *Juncus bulbosus* and *Utricularia minor* as companious

The *Sparganium minimum-Utricularia intermedia* association, described by TUXEN (1937), is not essentially different from the Sparganietum minimi Schaaf 1925 TUXEN (1937) considered *Sparganium minimum* and *Utricularia intermedia* the character taxa, whereas *Juncus bulbosus* and *Utricularia minor* are alliance character taxa

Sparganium minimum associations characterized by *Sparganium minimum* and one or more *Utricularia* species (*U minor*, *U intermedia* or *U ochroleuca*), have been mentioned by VANDEN BERGHEN (1947), VOLLMAR (1947), PFEIFFER (1951), TUXEN (1955), OBERBORFER (1957), JESCHKE (1959), NEUHAUSL (1959), MULLER & GORS (1960), PIETSCH (1963, 1965a, 1965b, 1971 MS), PASSARGE (1964), RUNGE (1966, 1969), OBERBORFER et al (1967) and DIERSSEN (1972)

The association was classified into the Littorellion by TUXEN (1937), VOLLMAR (1947), PFEIFFER (1951), OBERDORFER (1957) and JESCHKE (1959) Other phytosociologists have classified the association into the Helodo-Sparganion TÜXEN (1955), NEUHAUSL (1959) and RUNGE (1966), 1969) ALTEHAGE (1960) considers *Sparganium minimum* a character taxon of the Helodo-Sparganion

MULLER & GORS (1960) have split the latter alliance into a Hypericion elodis and a Sphagno-Utricularion both alliances within the Littorelletalia The Sparganietum minimi was classified by them into the Sphagno-Utricularion This classification was followed by PIETSCH (1963), PASSARGE (1964) and OBERDORFER et al (1967) The latter did not consider the Sphagno-Utricularion an alliance of the Littorelletea, but of the Utricularietalia intermedio-minoris Pietsch 1965, an order of the Utricularietea intermedio-minoris Pietsch 1965 The Sphagno-Utricularion was divided by OBERBORFER et al (1967) into two suballiances the Sphagno-Utricularion and the Scorpidio-Utricularion minoris The latter suballiance (in PIETSCH 1965b an alliance) consists of „mesotrophilic-neutrophilic" communities, and the Sparganietum minimi is one of the associations in this suballiance

PIETSCH (1971 MS) follows OBERDORFER et al (1967) as for the class and order, but he classifies the Sparganietum minimi into the Utricularion intermediae-minoris Pietsch 1965

In DIERSSEN (1972) the association is classified into the Juncetea bulbosi Tx & Dierssen 1971, order Utricularietalia Den Hartog & Segal (1964), alliance Utricularion (Den Hartog & Segal 1964) em Tx & Dierssen 1972 MS

Sparganium minimum can also be found in Eleocharetum multicaulis communities SCHWICKERATH (1933) and CHRISTIANSEN (1935) consider *Sparganium minimum* a character taxon of the „association of *Scirpus fluitans* and *Potamogeton polygonifolius*" Althought both authors have classified that association into the Potamion eurosibiricum, all association character taxa are characteristic of Littorelletea communities

LEBRUN et al (1949) described a subassociation of *Sparganium minimum* of the „association of *Heleocharis multicaulis* and *Scirpus fluitans*" The differential taxa of the subassociation are *Sparganium minimum*, *Utricularia intermedia, Cladium mariscus* and *Carex lasiocarpa*

Many phytosociologists assert, however, that *Sparganium minimum* is characteristic of the Potametea rather than of the Littorelletea KOCH (1926) considers *Sparganium minimum* a character taxon of the Potametum panormitano-graminei, as do BENNEMA et al (1943) The latter hold the view that *Sparganium minimum* is not so faithful a character taxon, since it is also found in the *Sparganium minimum – Utricularia intermedia* association in the Littorellion *Sparganium minimum* is not considered a character taxon of the latter association, because of its occurrence in the Potametum panormitano-graminei This species shows a higher combined estimation in the latter association, than in the *Sparganium minimum Utricularia intermedia* association, as is shown in the releves of BENNEMA et al (1943) WESTHOFF et al (1946) hold the same view as Bennema et al (1943)

DEN HARTOG & SEGAL (1964) and SEGAL (1965, 1968) have classified the „Sparganietum minimi (Schaaf 1925)*)" into the Potamion graminei, Luronio-Potametalia, Potametea

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*) The authors did not explain why „Schaaf (1925)" is placed in brackets

WESTHOFF & DEN HELD (1969) remark, however, that the Sparganietum minimi Schaaf 1925 differs from the communities, which are indicated by DEN HARTOG and SEGAL These communities are described in WESTHOFF & DEN HELD (1969) under the name „community of *Sparganium minimum* Westhoff 1968 n n" They occur in mesotrophic waters, in habitats with percolating water on the border of sand and fen regions An example of such a habitat is seen in MEYER & DE WIT (1955), who describe a community of *Sparganium minimum* and *Scirpus fluitans*
WESTHOFF & DEN HELD (1969) doubt whether the Sparganietum minimi Schaaf 1925 occurs in the Netherlands at present

V.6.2 The present relevés
table 18

The following subunits can be distinguished

I typical subassociation, Sparganietum minimi typicum
II subassociation of *Apium inundatum*, Sparganietum minimi apietosum
III. inpoverished subassociation, Sparganietum minimi inops
- a. variant of *Eleocharis multicaulis*
- b variant of *Potamogeton polygonifolius*
- c variant of *Potamogeton natans*
- d. variant of *Myriophyllum alterniflorum*

The present author did not contribute many relevés to the table, since the attention was focused on Littorelletalia communities The table therefore consists mainly of, hitherto unpublished, releves made by W Diemont, G Sissingh and the S O L -investigators

I typical subassociation
Relevés 1-11, with the differential taxa *Utricularia minor* and *U intermedia*, represent the Sparganietum minimi as described by SCHAAF (1925)
Sparganium minimum, *Utricularia minor* and *Juncus bulbosus* are constant species, *Utricularia intermedia*, *Eleocharis multicaulis*, *Phragmites australis*, *Potamogeton natans* and *Carex lasiocarpa* are present in half of the relevés *Scorpidium scorpioides* is only present, at least in this table, in releves without *Utricularia intermedia*, whereas *Sphagnum cuspidatum* is found only in relevés with *Utricularia intermedia* The Phragmitetea are well represented, and in almost all releves Potametea species are present, although with reduced vitality in many cases

All relevés are derived from the southern part of The Netherlands, from the province of North Brabant, particularly from the plant geographical Kempen district.

The soil in the stands was organic and weak. The water depth usually had values between 5 and 20 cm, but a depth of 75-100 cm was once measured (rel. 6).

All relevés are derived from moorland pools, in the process of autogenic succession Excavated peat holes are not represented in these relevés.

II. subassociation of *Apium inundatum* (relevés 12-15)

Utricularia minor and *U. intermedia* are absent from relevés 12-15. Character taxa of the Eleocharetum multicaulis are well represented, especially *Scirpus fluitans*. *Sparganium minimum* does not reach a high combined estimation value in these relevés.

Four species are found only in this group of relevés: *Apium inundatum*, *Glyceria fluitans*, *Galium palustre* and *Ranunculus flammula*.

The relevés are derived from the province of Overijssel in the north eastern part of The Netherlands.

The pools of this group are probably richer in nutrients than those of the former group. The presence of the nitrogen indicator, *Glyceria fluitans*, points in that direction.

The soil is peat sand. In two stands the water was below surface, in the remaining stands shallow water was noted (no further specification).

III. impoverished subassociation (relevés 16-32)

Relevés 16-32 have been classified into the impoverished subassociation. Within his subassociation four variants have been distinguished.

In the variants of *Eleocharis multicaulis* (IIIa, relevés 16-17) and of *Potamogeton polygonifolius* (IIIb, relevés 18-20) no character taxa of the Potametea are present. The sites with *Eleocharis multicaulis* have less deeper water than those with *Potamogeton polygonifolius*. In the site of rel. 19 from the latter variant, however, the phreatic level was below the surface, but the soil was waterlogged. In all stands the top layer of the soil consisted of organic matter.

In relevés 21-29 (IIIc) *Potamogeton natans* is a constant species; other character taxa of the Potametea are also well represented. The relevés represent a community which is intermediate between the Littorelletea and the Potametea. The habitat is also intermediate: the water is deeper than in most Littorelletea stands, and it is more eutrophic. The relevés are taken from sand

or humous sand
The *Echinodorus* species in rel 27 probably is *E repens*, as in the stand (Roevender Peel) only *E repens* is observed (KERN & REICHGELT 1950) Relevés 30-32 (IIId) are derived from the deepest water and from a sandy soil

V.6.3 Synecology

The Sparganietum minimi Schaaf 1925 is usually found in slightly enriched oligotrophic waters, on organic soils In some cases the association occurs in moorland pools, in the lee-side, where autogenic succession takes place (BENNEMA et al 1943) Usually the association is found in peat-cuttings, as is mentioned by WESTHOFF et al (1946), TUXEN (1937) PFEIFFER (1951), OBERDORFER (1957), MULLER & GORS (1960) and PIETSCH (1963)
Shallow water is mentioned by BENNEMA et al (1943), PFEIFFER (1951), NEUHAUSL (1959, 5-15 cm of water), RUNGE (1966, 1969) and DIERSSEN (1972) Deep water is mentioned by VOLLMAR (1947, 60-90 cm) and MULLER & GÖRS (1960, 20-150 cm)
The water is stagnant in most cases, VANDEN BERGHEN (1947) mentioned slowly running water Running water was also observed in the site of rel 28 in table 18
A pH of 6-6 5 was measured by VANDEN BERGHEN (1947), of 6 6-6 8 by PFEIFFER (1951) In VOLLMAR (1947) both the pH of the soil (6 7-6 8) and of the water above the soil (7 6-8) are given PFEIFFER (1951) executed some water analyses in *Sparganium minimum* stands, he measured 36-38 mg Ca^{2+}/l, 3 2-3 5 mg Mg^{2+}/l, 182-198 mg Cl^-/l and 10 8-12 4 mg SO_4^{2-}/l
PEARSALL (1920) mentioned a *Sparganium minimum* consocies, which is not identical to the typical Sparganietum minimi, since no *Utricularia* species are present *Sparganium minimum* is usually accompanied by *Eleodea canadensis* and *Potamogeton obtusifolius* The *Sparganium minimum* consocies is a community of deep water The light intensity at that depth is less than 15% of the intensity above the water surface The consocies occurs on a soil with 20-50% organic matter
In TANSLEY (1949) more details about this consocies are given, such as the water depth This is usually 2 4 3 m, and occasionally 1 2-1 8 m The consocies occurs on „loose, grey or yellowgrey mud" with 22 4% organic matter SPENCE (1964) mentioned a *Phragmites australis-Sparganium minimum*-

sociation occurring on organic soils in 8 to over 100 cm of water (mean value of 56 cm)
Sparganietum minimi inops communities, as rendered in IIIc, are frequently observed in ditches of fen regions in the Haff district, which receive percolating water from the adjacent pleistocene regions (Flora Neerl I 6 1964, WESTHOFF & DEN HELD 1969, WESTHOFF et al 1971)

V.6.4 Synchorology

The Sparganietum minimi Schaaf 1925 is reported from The Netherlands (table 18, BENNEMA et al 1943, WESTHOFF et al 1946), Belgium (VANDEN BERGHEN 1947, LEBRUN et al 1949), north-western France (GEHU & WATTEZ 1965), north western Germany (TUXEN 1937, PFEIFFER 1951, RUNGE 1966, 1969, DIERSSEN 1972), southern Germany (SCHAAF 1925, VOLLMAR 1947, OBERDORFER 1957, MULLER & GORS 1960, OBERDORFER et al 1967), Mecklenburg in north eastern Germany (JESCHKE 1959) and The Lausitz, south of Berlin (PIETSCH 1963). In Poland fragments of the association are mentioned by PODBIELKOWSKY (1960) and PIOTROWSKA (1966) NEUHAUSL (1959) mentioned the association from south eastern Czechoslovakia
The association may occur in Great Britain and Ireland, since *Sparganium minimum, Utricularia minor, U intermedia* and *Juncus bulbosus* are found there But until now the typical association has not yet been mentioned from that region

V.6.5 Discussion

Releves 1-11 in the present table clearly demonstrate that the Sparganietum minimi Schaaf 1925 occurs in The Netherlands, or at least occurred during G Sissingh's period of investigation (1941-1943) The fact that only one relevé of the S O L is present in this group, may indicate that the habitat of the typical subassociation has become very rare.
The present relevés of the typical Sparganietum minimi (relevés 1-11) are similar to the relevés of TUXEN (1937), VOLLMAR (1947), PFEIFFER (1951), OBERDORFER (1957), JESCHKE (1959) NEUHAUSL (1959), MULLER & GORS (1960) and PIETSCH (1963)
The relevés of PFEIFFER (1951) and OBERDORFER (1957), however,

contain *Ranunculus flammula* and *Galium palustre*. These species occur in the present table only in relevés 12-15, subassociation of *Apium inundatum*.
The relevés of RUNGE (1966, 1969) can be considered fragmentary representatives of the typical association; they are characterized by *Sparganium minimum*, whereas no *Utricularia* species are present. The relevés do not represent Potametea communities; species which characterize this (eutrophilic) class are absent, whereas the oligotrophilic species *Juncus bulbosus* and *Sphagnum cuspidatum* are constant species.
In the relevés of NEUHÄUSL (1959) *Carex lasiocarpa* has a high combined estimation value which is similar to some of the present relevés (2, 3, 4, 10, 11). *Carex lasiocarpa* is considered a differential taxon of the subassociation of *Sparganium minimum* of the Eleocharetum multicaulis by LEBRUN et al. (1949). The fact that the *Sparganium minimum* community is considered a subassociation of the Eleocharetum multicaulis, indicates a close relationship between both associations. This appears also from SCHWICKERATH (1933) and CHRISTIANSEN (1935) and from the present table, especially relevés 12-15. SCHWICKERATH (1933) and CHRISTIANSEN (1935) consider *Scirpus fluitans, Luronium natans, Hypericum elodes* fo. *natans, Apium inundatum, Potamogeton polygonifolius, Sparganium minimum, Pilularia globulifera* fo. *natans* and *Littorella uniflora* the character taxa of the „association of *Scirpus fluitans* and *Potamogeton polygonifolius*". All species mentioned are present in relevés 12-15.
There is no uniform opinion about the syntaxonomical position of the Sparganietum minimi, as the character taxon of the assosiation has a wide ecological amplitude and is found in a variety of communities. The present discussion of the syntaxonomical position of the association is based mainly on the typical subassociation; the remaining subassociations will be dealt with later.
The present author agrees with MÜLLER & GÖRS (1960) and DIERSSEN (1972) that the Sparganietum minimi has to be classified into the Littorelletea. The present association is related to the previously mentioned associations by *Juncus bulbosus*, which is a constant species in the association. Moreover, a number of character taxa of Littorelletea syntaxa is present, although they have a lower presence degree than *Juncus bulbosus*. The floristic differences between the Sparganietum minimi on the one side, and the previously mentioned five associations on the other side can be rendered best by classifying the former association into a separate order, viz. the Utricularietalia intermedio-minoris. This subject will come up for discussion in V.8.

WESTHOFF & DEN HELD (1969) have classified the „community of *Sparganium minimum*" into the order Luronio-Potametalia of the class Potametea In the view of the present author such communities (which are similar to those rendered in IIIc of table 18) are considered improverished representatives of the Sparganietum minimi Schaaf 1925, they should therefore be classified into the Littorelletea The same holds true for the subassociation of *Apium inundatum* and for the remaining variants of the impoverished subassociation.

V.7 Sphagno-Sparganietum angustofolii Tuxen 1937

V.7.1 Introduction

TUXEN (1937) distinguished this association under the name *Sparganium angustifolium-Sphagnum obesum* association, he considered *Sparganium angustifolium, Sphagnum obesum* (= *S crassicladum* var *obesum*), *S cuspidatum* var *plumulosum* and *Utricularia minor* the character taxa
The association is mentioned by many phytosociologists BENNEMA et al (1943), WESTHOFF et al (1946), LEBRUN et al (1949), PFEIFFER (1951), TUXEN (1955), MULLER & GORS (1960), RUNGE (1966, 1969), OBERDORFER et al (1967), WESTHOFF & DEN HELD (1969), PIETSCH (1965b, 1971 MS) and DIERSSEN (1972)
Many of these authors consider *Sparganium angustifolium, Sphagnum cuspidatum* var *plumulosum* and *S crassicladum* var *obesum* the association character taxa, whereas to others it is only *Sparganium angustifolium* TUXEN (1937) is the only person who considers *Utricularia minor* one of the character taxa Related associations have been mentioned by several authors the Isoeto-Sparganietum borderei (with *Sparganium angustifolium* ssp *borderei*) by BRAUN BLANQUET (1948), the Sparganietum borderei by NEGRE (1972), the Callitricho-Sparganietum affinis (=C S angustifolii) by BRAUN-BLANQUET (1954) and OBERDORFER (1957), (previously described under the name Sparganietum affine (sic) by OBERDORFER (1934)) and the Sparganieto-Isoetetum boryanae by RIVAS-MARTINEZ (1963)
The association was classified into the order Littorelletalia of the class Littorelletea by many phytosociologists, there was not so much unanimity concerning the alliance into which the association had to be classified The Sphagno-Sparganietum augustifolii was considered to belong to the Littorellion by TUXEN (1937), BENNEMA et al (1943), WESTHOFF et al (1946),

PFEIFFER (1951) and OBERDORFER et al. (1967); to the Helodo-Sparganion by LEBRUN et al. (1949), TÜXEN (1955) and RUNGE (1966, 1969); to the Sphagno-Utricularion by MÜLLER & GÖRS (1960).
PIETSCH (1965b, 1971 MS) classified the association into the Sphagno-Utricularion, order Utricularietalia intermedio-minoris, class Utricularietea intermedio-minoris.
DIERSSEN (1972) considered the Sphagno-Sparganietum angustifolii an association of the Utricularion (Den Hartog & Segal 1964) em. Tx. & Dierssen 1972 MS, order Utricularietalia (Den Hartog & Segal 1964) em. Tx.& Dierssen 1972 MS, class Juncetea bulbosi Tx.& Dierssen 1971.
WESTHOFF & DEN HELD (1969) treated the association in an appendix to the Scheuchzerietea Den Held, Barkman & Westhoff 1969, leaving open any decision whether it has to be assigned to the latter class or to the Littorellion
The Callitricho-Sparganietum (angustifolii) Br.Bl. was classified by BRAUN-BLANQUET (1954) and OBERDORFER (1957) into the Littorellion.

V.7.2 The present relevés
table 19

The relevés of this association are derived mainly from W. Diemont and from the S.O.L. investigators. Only a few relevés have been made by G. Sissingh and by the present author.
The relevés can be classified into:

I. subassociation of *Lobelia dortmanna*, Sphagno-Sparganietum angustifolii lobelietosum
II. subassociation of *Sphagnum* species, Sphagno-Sparganietum angustifolii sphagnetosum, variant of *Utricularia minor*
III. subassociation of *Sphagnum* species, impoverished variant

I. subassociation of *Lobelia dortmanna* (relevés 1-9)
The reléves of this subassociation are characterized by the presence of *Lobelia dortmanna, Isoëtes setacea, I. lacustris* and by the absence of *Utricularia minor, Potamogeton polygonifolius, Sphagnum crassicladum* and *S. cuspidatum.* A great number of character taxa of the Littorelletalia is present, although usually with a low presence degree (average 2.8 species per relevé). Mosses are absent except for *Drepanocladus fluitans* in two relevés.
All Dutch relevés belonging to this subassociation are derived from the

southern part of The Netherlands, from the plant geographical Kempen district. The relevés belonging to the subassociation sphagnetosum are all derived from the north eastern part of the country. Most relevés of the present subassociation were made in real moorland pools (no peat cuttings). The absence of *Sphagnum* species can be attributed to the exposed position of the pools to wind and waves (relevés 1-6,8) or to a rather high trophic level of the water (rel. 9) or to a combination of both factors.
In most stands an organic soil was noted. The water depth exceeds 20 cm in the majority of the stands.

II. subassociation of *Sphagnum* species, variant of *Utricularia minor* (relevés 10-18)

Differential taxa of this variant are *Utricularia minor, Potamogeton polygonifolius* and, to a lesser extent, *Sphagnum cuspidatum*. The differential taxon of the subassociation of *Sphagnum* species, *Sphagnum crassicladum*, is present in most relevés. This is a moderately oligotrophilic species, also found in the next variant. The strongly oliogotrophilic species *Sphagnum cuspidatum* is

Sphagno-Sparganietum angustifolii from the Brandeveen at Havelte, Drenthe. Photo by E.E. van der Voo.

found mainly in the present variant; this suggests that the present variant is characteristic of more oligotrophic water than the next variant. There are on the average 1.6 character taxa of the Littorelletalia present per relevé. Six pools are peat holes, whereas only three are moorland pools. The peat holes usually contain very oligotrophic water. Most stands are sheltered from winds, and no recreational activities were observed in the pools. In most sites an organic soil was observed.

In rel. 17 no *Sphagnum* species were noted, but *Scorpidium scorpioides* was the dominant moss. This species indicates a habitat that is richer in lime than the habitat of the remaining stands. The presence of *Utricularia minor* justifies the classification into this variant, however,

The water is at least 30 cm deep.

III. subassociation of *Sphagnum* species, impoverished variant (relevés 19-39)

The relevés of this variant can be characterized by the constant presence of *Sparganium angustifolium* and *Sphagnum crassicladum*. The relation with the Littorelletalia is weak, since *Juncus bulbosus, Littorella uniflora* and *Eleocharis multicaulis* have a low presence degree; there are on the average 0.4 character taxa of the Littorelletalia present per relevé.

In many pools of this variant recreational activities have been observed. They may be responsible for slight eutrophication, which, in turn, may be responsible for the near absence of the oligotrophilic *Sphagnum cuspidatum*. A number of pools does not lie sheltered from winds.

The soil was organic as in the other groups of relevés, and the water depth usually exceeds 25cm.

V.7.3 Synecology

The present relevés show that the Sphagno-Sparganietum angustifolii usually occurs in sheltered sites, in oligotrophic water, on an organic soil. The stands usually do not run dry in summer.

An extensive study of *Sparganium angustifolium* is made by E. van der Voo; his manuscript is not published, unfortunately. The most important results can be found in VAN DER VOO (1965) however. His data concerning the synecology of the association agree largely with in the data in the present work. VAN DER VOO (1965) notes that *Sparganium angustifolium* grows optimally on a muddy soil, whereas most stands of the present table are derived from organic soil. Quicksand is also a suitable substrate, according to

VAN DER VOO The tender root system of the species is best adapted to weak soils, generally speaking Most pools with Sphagno-Sparganietum angustifolii communities were found in the vicinity of blowing sand Organic waste products and artificial fertilizers from neighbouring agricultural land can therefore reach the pools, and cause a slight disturbance (VAN DER VOO 1965)

According to the same author, *Utricularia minor* is found together with *Sparganium angustifolium* only in extremely sheltered sites

WESTHOFF & DEN HELD (1969) state that the association is best developed in moorland pools that do not run in summer The water is meso-oligotrophic The proximity of blowing sand is also mentioned by them The same authors assert that an impoverished variant is found in peat waters This variant differs from the well developed association by the absence of *Sparganium angustifolium* and *Glyceria fluitans*

In BENNEMA et al (1943) the Sphagno-Sparganietum angustifolii is compared with the Isoeto-Lobelietum Both associations prefer the same water depth (20-80 cm), but they occur on different soils The Isoeto-Lobelietum is found on sandy soils, the Sphagno-Sparganietum angustifolii on muddy soils, rich in methane The latter soil is usually found on the west side of the pools, where the water movement is low

WESTHOFF et al (1946) consider pools on peat or sand soil, with dystrophic water, the specific habitat of the association Dystrophic water was also mentioned by LEBRUN et al (1949) and RUNGE (1966, 1969) TUXEN (1937) mentioned muddy soils and oligotrophic water

PIETSCH (1971) considers the Sphagno-Sparganietum angustifolii one of the associations which is characteristic of acid, oligotrophic peat water, rich in free CO_2

DIERSSEN (1972) mentioned the relatively deep water in which the association was found

NYGAARD (1938) studied pools and lakes in Denmark Two of the lakes contained Littorelletea communities, in both of them *Lobelia dortmanna, Isoetes lacustris, Littorella uniflora* and *Juncus bulbosus* were present, whereas *Sparganium angustifolium* was found in one lake only In that lake a pH of 4 3-5 4 was measured, and in the other lake the pH was 6 3-7 2 This indicates that *Sparganium angustifolium* prefers acid water The pH measurements in the present table show, however, that *Sparganium angustifolium* also tolerates slightly acid to neutral water

V.7.4 Synchorology

WESTHOFF & DEN HELD (1969) state that the Sphagno-Sparganietum angustifolii occurs in a large part of Europe, possibly in the whole of Europe excluding the mediterranean region

The association, as described by the methods of the Zurich-Montpellier School, is mentioned from Belgium (LEBRUN et al 1949), The Netherlands (table 19, BENNEMA et al 1943, WESTHOFF et al 1946, VAN DER VOO 1965, WESTHOFF & DEN HELD 1969), north western Germany (TUXEN 1937, 1955, RUNGE 1966, 1969, DIERSSEN 1972) and eastern Central Europe (PIETSCH 1971)

The association is also found in Ireland (table 19, relevés 17 and 9) and in Scotland (table 19, relevés 1-3) The Sphagno-Sparganietum angustifolii probably occurs in Scandinavia, which is the main distribution area of *Sparganium angustifolium* in Europe, but no studies according to the Zurich-Montpellier methods are available

In the U.S A a vicariant association with *Sparganium angustifolium* may occur (WILSON 1941, MUENSCHER 1944, JONES 1948, ROULEAU 1956, KNAPP 1965)

V.7.5 Discussion

The Sphagno-Sparganietum angustifolii, as described by TUXEN (1937), appears to be a clearly defined association The best resemblance with TUXEN's (1937) releves is found in the present table under the subassociation of *Sphagnum* sp variant of *Utricularia minor* Both differential taxa of this variant, *Utricularia minor* and *Potamogeton polygonifolius,* are mentioned by TUXEN

The majority of the releves of the variant of *Utricularia minor* was made more than 30 years ago, when eutrophication and pollution of moorland pools were still unimportant All releves of the typical variant were made more recently (1957-1959), when eutrophication was a real problem The two variants therefore represent different periods in time It is not sure whether the impoverished variant must be considered an impoverished form of the variant of *Utricularia minor* caused by eutrophication and pollution Most releves of the variant of *Utricularia minor* are derived from sites other than the releves of the impoverished variant and therefore, the stands of the impoverished variant do not necessarily originate from the stands of the variant of *Utricularia minor.* Relevés 12 and 30 are derived from the same pool in 1937 and 1959 respectively. The species *Potamogeton polygonifolius, Ultricularia minor, Juncus bulbosus* and *Sphagnum cuspidatum* are present in the former relevés, whereas they are absent in the latter.

The „Bergvennen" are represented in relevés 11 (variant of *Utricularia minor*) and 19 (impoverished variant); both relevés were made by W. Diemont in 1939. Relevés 26, 27, 33 and 34 are derived from the same group of pools; they were made by the S.O.L. investigators in 1958, and they all belong to the impoverished variant. Relevés 11 and 19, although classified into two different variants, differ mainly in respect to *Utricularia minor.* Relevés 26, 27, 33 and 34 are impoverished in comparison to the relevés made by W. Diemont; they all lack *Sphagnum cuspidatum* and *Juncus bulbosus* is absent in three of them. *Drepanocladus fluitans,* an indicator of a disturbed habitat, is present in most relevés of this group.

WESTHOFF & DEN HELD (1969) do not decide about classifying the Sphagno-Sparganietum angustifolii into an alliance and into syntaxa of a higher rank. The authors consider the relationship with the Littorellion slight; *Juncus bulbosus* is the only species in this association that is characteristic of Littorelletea communities. The Sphagno-Utricularion is rejected by the authors for floristic reasons. WESTHOFF & DEN HELD (1969) have treated the association in an appendix to the Scheuchzerietea, leaving open the decision whether it should be ranked under the Littorelletea or under the Scheuchzerietea. From the present material, however, it will be clear that the affinity to the Scheuchzerietea is smaller than that to the Littorelletea; in the present table no single character taxon of the Scheuchzerietea occurs. It is true that the constancy of the species *Sphagnum cuspidatum* and *S. crassicladum* suggests a relation to the Scheuchzerietea, but these *Sphagnum* species, though constantly occurring in the latter class, are no character taxa of it.

If one distinguishes two orders within the Littorelletea, as is done by the present author, then the Sphagno-Sparganietum augustifolii can be classified into the Littorelletea. A discussion of the two orders, Utricularietalia intermedio-minoris and Littorelletalia, is given in V.8.

The Sphagno-Sparganietum augustifolii is classified into the Utricularietalia intermedio-minoris, just as the Sparganietum minimum. No decision will be made yet concerning the alliance.

WESTHOFF & DEN HELD (1969) have observed the Sphagno-Sparganietum angustifolii frequently in metatrophic baitats, probably comparable to the habitat of relevés 19-39. The species *Potamogeton polygonifolius* and *Utricu-*

laria minor are not mentioned by these authors

VAN DER VOO (1965) states that *Sparganium angustifolium* finds optimal conditions in slightly acid, oligotrophic, slightly disturbed waters According to VAN DER VOO, the most characteristic taxa of this habitat are *Sphagnum crassicladum* (var *obesum*), *Eleocharis multicaulis*, *Menyanthes trifoliata*, *Potentilla palustris* as well as the ecotone species *Glyceria fluitans* and *Drepanocladus fluitans* These species are characteristic of the water regime of the pools where *Sparganium angustifolium* occurs They do not necessarily occur in the same stand as *Sparganium angustifolium*

The relevés of DIERSSEN (1972) of this association are very poor in species, as are the present relevés 19-39 DIERSSEN (1972) distinguishes two subunits In the subunit of *Sphagnum auriculatum* (the species *Sparganium angustifolium*, *Juncus bulbosus* and *Sphagnum „auriculatum"**) are present, these relevés best resemble relevés 21, 23 and 26 in the present table DIERSSEN's typical subunit is characterized by *Sparganium augustifolium* and *Potamogeton natans*, as are relevés 36 and 38 of the present table

Just like in The Netherlands, eutrophication has caused damage to the Sphagno-Sparganietum angustifolii in north western Germany, both in the number of localities and in the floristic composition (DIERSSEN 1972)

No eutrophication is observable from the table published by RUNGE (1966, 1969), he only mentioned oligotrophilic species, viz *Sparganium angustifolium*, *Juncus bulbosus*, *Sphagnum cuspidatum*, *Potamogeton polygonifolius* and *Utricularia minor*

The combination of *Sparganium augustifolium* with *Lobelia dortmanna*, *Littorella uniflora* and *Isoetes lacustris* is uncommon *Sparganium angustifolium* prefers a different type of soil than the three isoetid species, and therefore they are not frequently found together This community occurs somewhat often in Poland, as is reported by DAMBSKA (1967) It is found mainly in „suchartype" lakes, almost dystrophic lakes Slightly comparable communities are seen in the present table in releves 1-5

BRAUN-BLANQUET & TUXEN (1952) mentioned the occurence of *Sparganium angustifolium* in the „Eriocauleto-Lobelietum" in Ireland The association was observed in 20-50 cm of water, whereas *Sparganium angustifolium* only occured in water of 40-50 cm depth

PIETSCH (1963) published relevés of the Eleocharetum acicularis in which *Sparganium angustifolium* is present These relevés probably represent *Spar-*

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*) DIERSSEN uses the name *S auriculatum* to design *Sphagnum* sect *Subsecunda*, *S auriculatum* being one of the species grouped together in that section

ganium angustifolium stands from drained pools. *Eleocharis acicularis* may then invade unoccupied locations once the bottom has emerged.
The relevés published by BRAUN-BLANQUET (1948) under the name Isoëto-Sparganietum borderei correspond better with the Isoëto-Lobelietum than with the Sphagno-Sparganietum angustifolii. Two character taxa of the first association are present (*Isoëtes lacustris* and *Subularia aquatica*).
Formally the Isoeto-Sparganietum borderei can be considered a vicarious association besides the Sphagno-Sparganietum angustifolii, since both associations have a vicariant taxon: *Sparganium angustifolium* ssp. *borderei* and *Sparganium angustifolium* ssp. *angustifolium*. The first mentioned ssp. is only found in mountain lakes in the Pyrenees, where the second ssp. does not occur.
The Sparganietum borderei, mentioned by NÈGRE (1972) is a fragment of the Isoëto-Sparganietum borderei. NÈGRE (1972) did neither observe *Isoëtes lacustris* nor *Subularia aquatica* in his relevés, and therefore left „Isoëto" from the name of the association. Thus the Sparganietum borderei NÈGRE is much more related to the Sphagno-Sparganietum angustifolii that to the Isoeto-Lobelietum

V.8 The syntaxonomical position of the present associations

V.8.1 Introduction. Existing classifications

KOCH (1926) described the order Littorelletalia, as consisting of one alliance, the Littorellion; within this alliance two associations were described. The same order and alliance are mentioned by TÜXEN (1937), BENNEMA et al. (1943) and JESCHKE (1959).
BRAUN-BLANQUET & TÜXEN (1943) distinguished the Littorelletea into which they classified the Littorelletalia. They distinguished two alliances within the order: the Littorellion and the Helodo-Sparganion. The same classifications is given by BRAUN-BLANQUET & TÜXEN (1952), TÜXEN (1955), OBERDORFER (1957), TÜXEN & OBERDORFER (1958) and RUNGE (1966, 1969). These authors have different opinions about the content of the alliances; this will be discussed below.
Only one alliance, the Littorellion, was distinguished by WESTHOFF et al. (1946), WESTHOFF & DEN HELD (1969) and SCHOOF-VAN PELT & WESTHOFF (1969). LEBRUN et al. (1949) distinguished only the alliance. MÜLLER & GÖRS (1960) distinguished three alliances within the Littorelletalia: the Hypericion elodis, the Sphagno-Utricularion and the Littorellion. LOHMEYER et al. (1962) applied the same classification. PASSARGI

(1964) only recognized the Littorellion and the Sphagno-Utricularion within the Littorelletalia, whereas OBERDORFER et al (1967) only recognized the Hypericion elodis and the Littorellion

PIETSCH (1965a) divided the Littorelletalia into two new alliances the Lobelio-Isoeton and the Eleocharition acicularis VISSER & ZOER (1972) distinguished the same alliances

VANDEN BERGHEN (1969a) distinguished four alliances within the Littorelletalia the Utricularion, the Helodo-Sparganion, the Lobelio-Isoetion and the Eleocharition multicaulis In VANDEN BERGHEN (1964) the latter two alliances were considered suballiances of the Littorellion, with the names Lobelion and Eleocharition multicaulis, respectively

PIETSCH (1971, MS) designed a new subdivision of the Littorelletea

Order Littorelletalia
All Lobelio-Isoetion
All Eleocharition acicularis
Order Juncetalia bulbosi
All Hypericion elodis
All Juncion bulbosi

Several phytosiologists have arranged sections of the Littorelletea into a new class PIETSCH (1965b) described the class Utricularietea intermedio-minoris with the order Utricularietalia intermedio minoris containing the alliances Scorpidio-Utricularion minoris and Sphagno-Utricularion minoris PIETSCH (1971, MS) has maintained this classification, but the former alliance was named Utricularion intermedio-minoris OBERDORFER et al (1967) recognized the same class and order, with one alliance, the Sphagno-Utricularion This was then subdivided into two suballiances the Sphagno-Utricularion and the Scorpidio-Utricularion minoris

DIERSSEN (1972) unified the higher syntaxa, which were separated by PIETSCH (1965b) The classification by DIERSSEN is as follows

Class Juncetea bulbosi
Order Utricularietea
All Utricularion
Order Littorelletalia
All Ranunculion reptantis
All Myriophyllo (alterniflori)-Lobelion
All Hydrocotylo-Baldellion

DEN HARTOG & SEGAL (1964) and SEGAL (1965) presented a different division They distinguished the Littorelletea, the Littorelletalia and the Littorellion, and also the Hypericion elodis The syntaxonomical position of the latter alliance was left undecided by the authors, but they reject classification into the Littorelletalia. In SEGAL (1965) the Hypericion elodis is classified into the Littorelletalia however.

Since the Littorelletalia communities are bound to habitats with fluctuating water level, temporarily running dry, it is not astonishing that transitions can be observed between these communities and the associations of the class Potametea, which are bound to permanent fresh water. It may be supposed, that some species present their joint optimal occurence particularly in these transitional communities. If this hypothesis could be confirmed, a higher syntaxon (alliance or order), characterized by the later species group, may be described. This has been done indeed by DEN HARTOG & SEGAL (1964) and SEGAL (1965, 1968), who described the order Luronio-Potametalia with one alliance, the Potamion polygonifolii. They consider this order to belong to the Potametea; it consists of communities that are closely related to the Littorelletea. Whether the distinction of this separate unit is justified will be considered below.

The classification of SEGAL (1968) differs from the preceding one by the fact that two alliances are distinguished within the Littorelleatalia: the Littorellion and the Elatinion. SEGAL (1968) also mentions the Juncion bulbosi, which is classified into the Littorelletea, however, without assigning it to any order. The Luronio-Potametalia are mentioned by PIETSCH (1965a), WESTHOFF & DEN HELD (1969) and VISSER & ZOER (1972).

LOUIS & LEBRUN (1942) have classified the Littorelletalia and the Littorellion into the Isoeto-Nanojuncetea, VLIEGER (1937) and NEUHÄUSL (1959) classified them into the Isoeto-Littorelletea. All these authors have unified Nanocyperion communities and Littorelletalia communities in one class.

HADAČ (1971), studying the vegetation of Iceland, distinguished two alliances within the Icelandic Littorelletalia: the Isoetion lacustris and the Subularion aquaticae.

V.8.2 Discussion. Classification of the present associations and comparison with classification systems previously published

All relevés from the present study have been unified into a synoptic table (table 20). Taxa, occurring in 10 or less relevés are omitted, since they are not important for classification of the associations. They have been mentioned in separate tables.

The table shows that the most characteristic forms of the Sphagno-Sparganietum angustifolii and of the Sparganietum minimi differ rather strongly from all other associations These forms are the Sphagno-Sparganietum angustifolii sphagnetosum, variant of *Utricularia minor*, and the Sparganietum minimi typicum The former two associations are related to the other ones mainly by the presence of *Juncus bulbosus*, whereas character taxa of the Isoeto-Lobelietum and the Eleocharetum multicaulis are present in some subunits of the two associations

The table shows also that the Eleocharetum multicaulis, the Pilularietum, the Eleocharetum acicularis and the Samolo-Littorelletum are more closely related to each other than to the Isoeto-Lobelietum These differences and similarities can be rendered best if the Sphagno-Sparganietum angustifolii and the Sparganietum minimi are classified into one order, and the remaining associations into another Two alliances have to be distinguished within the latter order, one consisting of the Isoeto-Lobelietum and the other consisting of the Eleocharetum multicaulis, the Pilularietum, the Eleocharetum acicularis and the Samolo-Littorelletum We must consider whether a similar classification has been published before

Since all associations in the present study are unified in a single class, this class can keep the name Littorelletea Br Bl & Tx 1943 The classification systems of KOCH (1926), TUXEN (1937), BENNEMA et al (1943), WESTHOFF & DEN HELD (1969) and SCHOOF-VAN PELT & WESTHOFF (1969) are not adequate since they are dealing with only one alliance within the Littorelletea

BRAUN-BLANQUET & TUXEN (1943) were first to distinguish two alliances within the Littorelletea The new alliance, the Helodo-Sparganion, was published as a nomen nudum, however Information about the Helodo-Sparganion is given by BRAUN-BLANQUET & TUXEN (1952) in their description of the vegetation of Ireland They give a plant geographical interpretation of the alliance by calling it an „Iberian alliance, which occurs in a weakened from also in western France and Ireland, and which irradiates into north western Germany" BRAUN-BLANQUET & TUXEN (1952) mentioned the *Potamogeton polygonifolius-Hypericum elodes* association and the *Ranunculus omiophyllus* (=*R lenormandii*) community as belonging to the Helodo-Sparganion The association was first described by ALLORGE (1926) The suggestion is made that *Eleocharis multicaulis* plays a prominent part in the Helodo Sparganion, since the authors consider *Eleocharis multicaulis, Juncus bulbosus* and *Scirpus fluitans* the most important species of the auogenic succession The fact that the Eleocharetum multicaulis (character taxon *Eleocharis multicaulis*) is classified into the Littorellion by the authors, is at least astonishing

TUXEN & OBERDORFER (1958) consider *Eleocharis multicaulis* a character taxon of the Littorelletalia, whereas the Eleocharetum multicaulis is classified into the Helodo-Sparganion

TÜXEN (1955) distinguished the Helodo-Sparganion and the Littorellion From the associations, .that are classified into the alliances, one gets the impression that TUXEN gives an ecological rather than a plant geographical interpretation of the alliances The Littorellion is, acoording to TUXEN (1955), an alliance of shore communities on mineral soil, in which *Littorella uniflora* is the characteristic species The Helodo-Sparganion consists of communities on organic soils, and is characterized by *Sphagnum* species

RUNGE (1966, 1969) follows most of TUXEN's (1955) subdivision, but the classifies the Eleocharetum multicaulis into the Littorellion, in contrast with TUXEN

OBERDORFER (1957) gives a plant geographical interpretation of the two alliances Communities with a great share of atlantic species are classified into the Helodo-Sparganion The Littorellion communities are characterized by a „northern-subatlantic" distribution As a consequence of this view the Sparganietum minimi and the Callitricho-Sparganietum are classified into the latter alliance, although the Helodo-Sparganion is named after the *Sparganium* species

None of the enumerated systems can be applied to the present table, since the Sparganietum minimi and the Sphagno-Sparganietum angustifolii are not classified into a separate order

MULLER & GORS (1960) distinguished three alliances within the Littorelletalia They classified communities characterized by *Sparganium angustifolium, S. minimum,* various *Utricularia* species and various *Sphagnum* species into the Sphagno-Utricularion, a new alliance The remaining alliances of the Littorelletalia are the Littorellion and the Hypericion alodis The latter is a provisional alliance of MULLER & GORS

Hypericum elodes and *Potamogeton polygonifolius* are considered character taxa of that alliance Both species are strongly represented however in the subassociation of *Potamogeton polygonifolius* of the Eleocharetum multicaulis in north western Germany and in The Netherlands This association is assigned to the Littorellion After quoting BRAUN-BLANQUET & TUXEN (1952), who state that that community is complex and implicitely presume that in north western Germany it may be split into the Potameto-Hypericetum elodis and pure Eleocharetum multicaulis, MULLER & GORS

(1960) actually carry out this splitting. Without justification they apply the same treatment to relevés of the Eleocharetum multicaulis, published by BENNEMA et al. (1943).
In the synoptic table of the Potameto-Hypericetum elodis (according to MULLER & GORS (1960) this is an association of the Hypericion elodis) the species *Hypericum elodes* and *Potamogeton polygonifolius* both occur with presence degree V (MULLER & GORS 1960). *Eleocharis multicaulis* occurs in one relevé, whereas the whole association is based on six releves, from Ireland. In the table of the Eleocharetum multicaulis, which is classified into the Littorellion, *Eleocharis multicaulis* and *Hypericum elodes* reach presence degree V, and *Potamogeton polygonifolius* reaches presence degree II. This table is based on 22 relevés from north western Germany and The Netherlands. MULLER & GORS (1960) have placed the presence degrees of *Hypericum elodes* and *Potamogeton polygonifolius* in brackets, because they hold the view that the relevés are too complex. This is not the opinion of the present author. Present tables (7-10, 12-14) of the Eleocharetum multicaulis show that relevés with *Hypericum elodes* and/or *Potamogeton polygonifolius* usually contain *Eleocharis multicaulis* as well. This is also the case in small sample plots. This opinion implies that *Hypericum elodes* and *Potamogeton polygonifolius* cannot be considered character taxa of the Hypericion elodis. Since no other species are available to distinguish the Hypericion elodis from the other alliances, the Hypericion cannot be maintained. The releves of the so-called Potameto-Hypericetum elodis can best be regarded as fragments of the Eleocharetum multicaulis.
MULLER & GORS (1960) also published Eleocharetum multicaulis relevés, which lack *Hypericum elodes* and *Potamogeton polygonifolius*. These relevés should justify their opinion about the Hypericion elodis. However the argument is not very convincing, since these relevés do not represent optimal circumstances. Part of the relevés is derived from Brandenburg in east Germany, where (sub)atlantic species such as *Eleocharis multicaulis, Hypericum elodes* and *Potamogeton polygonifolius* are extremely rare or absent. The remaining releves are derived from Ireland, from very oligotrophic water, i.e. from lakes within the blanket bog ecosystem. To the experience of the present author *Hypericum elodes* and *Potamogeton polygonifolius* are usually absent in such habitats, they are found in water which is slightly enriched in nutrients, e.g. in streamlets or near the coast. However, in such situations they are always growing together with *Eleocharis multicaulis*.
PASSARGE (1964) only recognized the Sphagno-Utricularion and the Littorellion within the Littorelletalia, his classification cannot be used for the

present material.
DEN HARTOG & SEGAL (1964) accept only one alliance within the Littorelletalia, viz. the Littorellion. They regard the Hypericion, with species „such as *Hypericum elodes, Eleocharis multicaulis, Echinodorus ranunculoides, E. repens, Deschampsia setacea, Juncus bulbosus* and *Scirpus fluitans*" a good alliance.
The authors do not classify the latter alliance into the Littorelletea, however, since the mentioned species are not true water plants. This decision is based on *structural* properties of the vegetation. DEN HARTOG & SEGAL (1964) leave the syntaxonomical position of the Hypericion undecided „until more is know about its *floristic* composition and its affinities to other vegetation units." This means that the new syntaxonomical position of the alliance must be based on *floristic* criteria. Since these criteria have been previously applied in assigning the Hypericion to the Littorelletalia by MÜLLER & GÖRS (l.c.), it is clear that DEN HARTOG & SEGAL halt between two opinions.
SEGAL (1965) has classified the Hypericion elodis into the Littorelletalia. SEGAL (1968) omits the Hypericion elodis from the Littorelletalia, and he distinguishes two alliances within this order: the Littorellion and the (provisionary) Elatinion. The latter constitutes transitions to the Nanocyperion. The species which were formerly classified into the Hypericion, are now classified into a new alliance: the Juncion bulbosi. This is assigned tto the Littorelletea. No order is mentioned, however.
DEN HARTOG & SEGAL (1964) described the Luronic-Potametalia as an order of the Potametea, consisting of communities which are closely related to the Littorelletea. These communities were separated from the Littorelletea, because of „the completely different life-form spectrum, as well as the almost total absence of isoetids" according to the authors. They also state that „the order is extremely well characterized in floristic respect".
DEN HARTOG & SEGAL (l.c.) consider *Potamogeton polygonifolius, P. gramineus, Sparganium minimum, Luronium natans, Myriophyllum alterniflorum* and *Ranunculus omiophyllus* the faithfull taxa. DEN HARTOG & SEGAL (l.c.) distinguished one alliance, the Potamion polygonifolii, within the order; the alliance consists of three associations: the Myriophylletum alterniflori Lemée 1937, the Potametum panormitano-graminei Koch 1926 and the Sparganietum minimi (Schaaf 1925).
The first association should be assigned to the Nymphaeion, in the opinion of the present author. Apart from *Myriophyllum alterniflorum* all five relevés in LEMEE's table contain *Nymphaea alba, Polygonum amphibium* fo. *natans* and *Potamogeton natans.* These three taxa are character taxa of the

Nymphaeion. *Potamogeton gramineus* is seen in three relevés.

A comparable community is presented by JESCHKE (1959). This author shows relevés of the Parvopotametum, which is assigned to the Parvopotamion. JESCHKE's relevés correspond with those presented by LEMÉE (1937), by the presence of *Myriophyllum alterniflorum, Characeae, Polygonum amphibium* fo. *natans* and *Potamogeton gramineus.* The constancy of *Littorella uniflora* in the relevés of JESCHKE distinguishes them from the relevés of LEMÉE (1937). A community which is closely related to the Parvopotametum is presented in the „*Myriophyllum alterniflorum-Littorella uniflora*-Gesellschaft" by JESCHKE (1959). Potametea taxa are rare, but instead *Phragmites australis* is a constant species. JESCHKE (l.c.) assigned this community to the Littorelletalia.

However, *Myriophyllum alterniflorum* has a stil wider amplitude than would appear from the tables of LEMÉE (1937) and JESCHKE (1959); reference is made to the discussion of MULLER & GÖRS (1960, p. 94). In The Netherlands, previously its optimal occurrence was in the Myriophylletum alterniflori Sissingh apud Bennema et al. 1943, an association characteristic of clear, unpolluted rivulets on poor sandy soils. *Luronium natans* is seen in both relevés of the table presented by BENNEMA et al. (1943); according to the authors this species is a character taxon of the Littorellion. The association took an intermediate position between the Littorelletea and the alliance Callitricho-Batrachion (order Potametalia).

It is most regrettable that the Myriophylletum alterniflori can hardly be studied any more; as a consequence of general water pollution within the last twenty years it has completely disappeared from The Netherlands and many adjacent territories. According to WEBER-OLDECOP (1969) the association is still found in north western Germany.

The Sparganietum minimi Schaaf 1925 is characterized by *Juncus bulbosus, Sparganium minimum, Utricularia minor* and *U. intermedia.* According to the material published by SCHAAF (1925), TÜXEN (1937), BENNEMA et al. (1943), VOLLMAR (1947), PFEIFFER (1951) and JESCHKE (1959), taxa of the Potametea usually have a lower presence degree and combined estimation than taxa of the Littorelletea. *Luronium natans, Myriophyllum alterniflorum* and *Potamogeton gramineus* are lacking in all mentioned relevés. There is more argument, therefore, to assign the Sparganietum minimi to the Littorelletea rather than to the Potametea.

DEN HARTOG & SEGAL (1964) have placed the name Schaaf 1925 in brackets; they probably have a different conception on the association. This is not explained by the authors, however.

At least in The Netherlands, *Sparganium minimum* is not restricted to the association to which it is supposed to be characteristic WESTHOFF & DEN HELD (1969) described a „community of *Sparganium minimum*" occuring in deeper and more eutrophic water, presenting some character taxa of Potametea and Lemnetea, but only a few of the Littorelletea This community corresponds with „relevés 21-29" of table 18, and with the Potametum panormitano-graminei as presented in BENNEMA et al (1943) In the releves of table 18, the group value of the Potametea character taxa exceeds that of character taxa of the Littorelletea However, if the association is considered in its totality, it is clear that it should be assigned to the Littorelletea

KOCH (1926) described an association Potametum panormitano-graminei, which he assigned to the Potamion eurosibiricum *Potamogeton panormitanus* is a synonym of *P pusillus* L s s (i e after splitting of *P pusillus* L s l in *P berchtoldii* Fiebr and *P pusillus* L s s) PASSARGE (1964) renamed the association Potametum graminei, but without sufficient justification The latter name has been taken over by WESTHOFF & DEN HELD (1969) In the opinion of the present author, however, the name Potametum panormitano-graminei Koch 1926 should be preserved for sake of priority *Potamogeton gramineus* seems to be the only character taxon of the association in The Netherlands. *P pusillus* has a wider amplitude in Parvopotamion communities According to KOCH's table, the Potametum panormitano-graminei must be assigned to the Potametea and not to the Littorelletea If the order Luronio-Potametalia is accepted, the Potametum panormitano-graminei would be an example of it, *Potamogeton alpinus* and Sparganium minimum occur in it as constant species (presence 60%)

In The Netherlands, the Potametum panormitano-graminei has been mentioned by BENNEMA et al (1943, table with four releves), WESTHOFF (1947) and WESTHOFF & DEN HELD (1969) Conclusion two associations (Potametum panormitano-graminei and Myriophylletum alterniflori Sissingh) among those discussed above hold a position which is intermediate between the class Potametea and the class Littorelletea, and the erection of an order containing these two associations may be considered It appears on closer examination, however, that none of the supposed character taxa of the order is found in both associations The supposed character taxa are either character taxa of one of the two associations (*Potamogeton gramineus* and *Myriophyllum alterniflorum*), or they find their occurrence in the Littorelletea (*Potamogeton polygonifolius, Sparganium minimum, Luronium natans*) The last character taxon of the order erected by DEN HARTOG & SEGAL is *Ranunculus omiophyllus* (=*R lenormandii*) BRAUN-BLANQUET & TUXEN

(1952) published one relevé containing species: the relevé is more related to the Littorelletea than to the Potametea, but more relevés are necessary in order to show whether this is always the case.
The identity and independence of the order Luronio-Potametalia is, therefore, not obvious and there does not seem sufficient reason to distinguish it.
PIETSCH (1965b) has separated the Sphagno-Sparganietum angustifolii and the Sparganietum minimi from the Littorelletea. He described a new class and a new order, in which associations that are characterized by *Sphagnum* species, *Utricularia* species and *Sparganium* species are unified. The class Utricularietea intermedio-minoris, and the order Utricularietalia intermedio-minoris contain two alliances. In the Sphagno-Utricularion minoris the associations of acid water are unified, in the Scorpidio-Utricularion minoris the associations of slightly acid to alkaline water are unified. The Sphagno-Sparganietun angustifolii is classified into the Sphagno-Utricularion minoris, and the Sparganietum minimi into the Scorpidio-Utricularion minoris.
OBERDORFER et al. (1967) follow this classification, but they attach the rank of suballiances to PIETSCH's (1965b) alliances. They classify the Sphagno-Sparganietum angustifolii into the Littorellion. They also dinstinguish two alliances within the Littorelletalia: the Hypericion elodis and the Littorellion. The former alliance is represented fragmentarily by one association in southern Germany; the latter alliance is represented by twelve associations. This way of subdividing the Littorelletalia is not at all relevant for the present material. The Hypericion elodis with the Hypericeto-Potametum is not recognized by the present author, since it is never observed. According to OBERDORFFER et al. (l.c.) all remaining associations (almost all associations from the present table) are classified into the Littorellion. In conclusion, the classification proposed by OBERDORFER et al. (l.c.) does not contribute to a true subdivision of the Littorelletalia associations.
VANDEN BERGHEN (1964) distinguished two suballiances within the Littorellion. The Lobelion is characterized by *Lobelia dortmanna* and by various *Isoëtes* species; associations of this suballiance are found in rather deep water. The second suballiance, the Eleocharition multicaulis, consists of associations of less deep water. Differential taxa of this suballiance are not given by VANDEN BERGHEN (1964). In VANDEN BERGHEN (1969a) both suballiance are elevated to alliance. The Littorelletalia then consist of four alliances: the Utricularion Den Hartog & Segal, the Lobelio-Isoëtion Pietsch, the Eleocharition multicaulis Vanden Berghen, and the Helodo-Sparganion Braun-Blanquet & Tüxen. The latter alliance is considered synonymous with the Hypericion elodis Müller & Görs. Tables, published by VANDEN

BERGHEN (1969a), show that the Eleocharition multicaulis and the Helodo Sparganion differ from each other only in minor details, at least in south western France In addition, in the opinion of the present author, these alliances should be united, because BRAUN-BLANQUET & TUXEN (1952), the authors of the Helodo-Sparganion, claim this alliance is optimally developed in atlantic south western Europe If these alliances are unified, the Lobelio-Isoetion on one side and the Eleocharition multicaulis together with the Helodo-Sparganion on the other side correspond with the two alliances distinguished in the present table 20

PIETSCH (1965a) distinguished two alliances within the Littorelletalia the Lobelio-Isoetion and the Eleocharition acicularis The alliance are comparable to the Lobelion and the Eleocharition multicaulis in VANDEN BERGHEN (1964) The syntaxa, which are distinguished by VANDEN BERGHEN (1964, 1969a) have a limited geographical value, since they refer to south western France only The classification of PIETSCH (1965a), on the other hand, is based on associations from central and western Europe, and has therefore a larger geographical value

PIETSCH (1971, MS) distinguished two orders within the Littorelletea the Littorelletalia and the Juncetalia bulbosi The former order, with the alliances Lobelio-Isoetion and Eleocharition acicularis, does not fundamentally differ from the order as it is treated in PIETSCH (1965a) The Juncetalia bulbosi consist of communities from habitats with an extremely lop-sided ecology The water is extremely acid, which is partly due to the presence of free sulphuric acid, the soil is rich in organic matter, or in silt with a high content of iron-hydroxide Two alliances are classified into this order the Hypericion elodis and the Juncion bulbosi The former alliance is not represented by any association in central Europe and is, therefore, not further considered by PIETSCH, the latter alliance is represented by six associations They are the Juncetum bulbosi, the Sphagnetum cuspidato-obesi Tuxen & v Hubschmann 1958, the Sphagno (obesi)-Juncetum bulbosi Grosser 1959, the Junco (bulbosi)-Eleocharitetum multicaulis Pietsch 1971, the Ranunculo (flammulae)-Juncetum bulbosi Oberd 1957 and the *Utricularia minor Juncus bulbosus* Gesellschaft Most of these syntaxa can be regarded as fragments of Littorelletea communities or Utricularietea intermedio-minoris communities, conditioned by extreme habitats It is the opinion of the present author that PIETSCH is not justified in creating a separate order for such communities The only character taxon which they have in common is *Juncus bulbosus* This species, however, is equally present in communities of the Littorelletalia sensu PIETSCH

DIERSSEN (1972) proposed the following classification. Communities which are characterized by *Utricularia* species, *Sparganium* species and *Sphagnum* species are classified into the Utricularietalia Den Hartog & Segal 1964 with one alliance, the Utricularion (Den Hartog & Segal) em. Tx. & Dierssen 1972 MS. The Utricularietalia are unified with the Littorelletalia into the Juncetea bulbosi Tx. & Dierssen 1971. The Littorelletalia consist of three alliances: the Ranunculion reptantis Tx., Géhu, Dierssen 1972 MS, the Myriophyllo (alterniflori)-Lobelion (Vanden Berghen 1964) Tx. & Dierssen 1972 MS and the Hydrocotylo-Baldellion Tx. & Dierssen 1972 MS. The Ranunculion reptantis will not be considered here. Communities of this „circumboreal alliance" have not been studied by the present author, and their status is not relevant to this discussion. The classification by DIERSSEN (1972) fits very well to the present table: the Sphagno-Sparganietum angustifolii and the Sparganietum minimi are classified into a separate order; the Isoëto-Lobelietum is placed in one alliance of the Littorelletalia, and the Eleocharetum multicaulis and the Pilularietum globuliferae in another alliance of that order. DIERSSEN (1972) did not give his opinion of the syntaxonomical position of the Eleocharetum acicularis and the Samolo-Littorelletum, since these associations did not occur in his study region.
DIERSSEN (1972) referred to rather inaccessible studies. It is hard to understand why he has applied so many new names to syntaxa that are similar to syntaxa which have already been published. This confusing introduction of names is at variance with any reasonable nomenclature and with the current nomenclatural practice. Use is made only of DIERSSEN's classification *system*, not the *names* that he applied to the syntaxa. In the opinion of the present author these names are superfluous.

V.8.3 Conclusion

The name Littorelletea Br.-Bl. & Tx. 1943 will be used for the class; the name Utricularietalia intermedio-minoris Pietsch 1965 for one order and the name Littorelletalia W. Koch 1926 for the other order. The latter order consists of two alliances; they are the Lobelio-Isoëtion Pietsch 1965 and the Eleocharition acicularis Pietsch 1965. The name Eleocharition multicaulis, as used by VANDEN BERGHEN (1969) would suit the latter alliance better, but the name used by PIETSCH (1965a) is older.
The name Littorellion has not been applied to one of the alliances, although the rules of nomenclature advise that the name of a syntaxon must be applied

to one of the new syntaxa, which arise when the original syntaxon is split into units of equal rank (MORAVEC 1968, article 13) The discussion in this chapter has shown already that the name Littorellion has been given to alliances with very different contents Instead of increasing the confusion by using the name again, in another different sense, two other names have been used

The name Utricularietalia Den Hartog & Segal 1964 cannot be applied, since this order contains communities that consist only of *Utricularia* species No *Sparganium* species or *Sphagnum* species occur in these communities, as they have been conceived by the latter authors

The syntaxonomical division of the Littorelletea, as conceived by the present author, is

Class	Littorelletea Br Bl & Tx '43	
character taxon		*Juncus bulbosus*
Order 1	Littorelletalia Koch '26	
ch taxa		*Littorella uniflora*
		Luronium natans
		Elatine hexandra
Alliance 1	Lobelio-Isoetion Pietsch '65	
Association 1	Isoeto-Lobelietum (Koch '26) Tx '37	
ch taxa of all and ass		*Lobelia dortmanna*
		Isoetes setacea
		Isoetes lacustris
		Subularia aquatica
		Eriocaulon septangulare (occurring in western Ireland only)
Alliance 2	Eleocharition acicularis Pietsch '65	
ch taxa		*Echinodorus ranunculoides*
		Apium inundatum
Association 2	Eleocharetum multicaulis All '22 em Tx '37	
ch taxa		*Eleocharis multicaulis*
		Scirpus fluitans
		Hypericum elodes
		Deschampsia setacea
		Ranunculus ololeucos
		Echinodorus repens
		Potamogeton polygonifolius

Association 3	Pilularietum globuliferae Tx ex Muller & Gors '60	
ch taxon		*Pilularia globulifera*
Association 4	Eleocharetum acicularis Koch '26	
ch taxon		*Eleocharis acicularis*
Association 5	Samolo-Littorelletum Westh '43	
differential taxa		*Samolus valerandi*
		Carex trinervis
		Salix repens
Order 2	Utricularietalia intermedio-minoris Pietsch '65	
ch taxa		*Utricularia minor*
		Utricularia intermedia
Association 6	Sparganietum minimi Schaaf '25	
ch taxon		*Sparganium minimum*
Association 7	Sphagno-Sparganietum angustifolii Tx '37	
ch taxon		*Sparganium angustifolium*

No decision is presented concerning alliances within the Utricularietalia intermedio-minoris

Finally, a remark has to be made on the Eleocharition acicularis Table 20 shows that the Agropyro-Rumicion crispi can be considered a differential syntaxon of the alliance Moreover, the taxa *Ranunculus flammula, Mentha aquatica* and *Galium palustre*, which are also indicators of disturbances in the habitat, show their highest presence degree in the Eleocharition acicularis This alliance, therefore, has to be regarded as an „ecotone alliance" It is the fluctuating water level which is responsible for the instability in time, the communities of this alliance are inundated during part of the year, whereas they are exposed to the air during another part The communities of the Lobelio-Isoetion and of the Utricularietalia intermedio-minoris usually stay inundated the whole year through, their habitat is therefore more stable

Chapter VI

DISTRIBUTION AND ECOLOGY OF CHARACTER TAXA OF THE LITTORELLETEA

The aim of this chapter is not to give a full description of the ecology of the species, since this subject has been studied and described in detail in the past Moreover, an extensive description would be a repetition of many facts, given in chapter V In this chapter, therefore, only a short survey is presented, together with some new facts

The Littorelletea taxa *Sparganium angustifolium, S minimum, Utricularia minor* and *U intermedia*, which have not been studied by the present author, are omitted

As many species in question have a somewhat atlantic distribution, the diagnosis of their area is taken from DUPONT (1962) who made a detailed study of the atlantic flora

In the life form system of IVERSEN (1936) many Littorelletea taxa are amphiphytes, i e species which are adapted to both a life in air and in water Some Littorelletea taxa are considered limnophytes by IVERSEN, i e water plants, whose vegetative and floral shoots become reduced in land forms

In the life form system of HEJNY (1960), the species *Eleocharis acicularis, Juncus bulbosus, Littorella uniflora* and *Pilularia globulifera* are considered tenagophytes The life forms in HEJNY are distinguished according to their adaptations to the water level HEJNY used the term ecophase, indicating a temporary habitat, in which a specific ecological factor (e g the water level) plays an important part Four ecophases are distinguished The hydrophase is a habitat with a high water level, which enables the adaptation of species which are strictly bound to the hydrophase The litoral phase is the habitat with a shallow water level, which enables the adaptation of perennial species, these species are bound to a life in the hydrosphere as well as in the atmosphere and they need a succession of the separate ecophases for their full development The limose phase is a habitat without a distinct layer of water, the soil is waterlogged, however The terrestrial phase is a habitat, in which the water regime of the soil is the controlling factor

Tenagophytes are species whose life cycle is bound to the shallow litoral phase. They are adapted to a longlasting existence in the litoral and limose phase. They can survive only shorlty in the hydrophase and terrestrial phase. Germination and beginning of the development take place in the litoral phase, sexual reproduction in the litoral and limose phase, and dissemination in the terrestrial phase. Pollination takes place in the contact zone or in the air, during the limose phase. The species then need a high air humidity and high temperatures. Vegetative reproduction (if this occurs) takes place in the litoral to limose phase. When the water level rises in summer, the plants get adapted temporarily to the hydrophase; their vegetative shoots are extended to the contact zone.

Almost all chracater taxa of the Littorelletea belong to this group, according to HEJNÝ. *Isoëtes lacustris* and *I. setacea*, classified by HEJNÝ into the tenagophytes, cannot be considered representatives of this group, as they are usually living in deep water.

Apium inundatum

This species is found in southern Sweden, Denmark, north western Germany, as far as Mecklenburg, Lausitz (PIETSCH 1963), The Netherlands, Belgium, the greater part of the British Isles, western and central France, Portugal and the atlantic part of Spain, north and north western Morocco, Tunisia and various parts of western Italy and Sicily. The area is considered atlantic for the greater part by DUPONT (1962), but because *Apium inundatum* is also found in Italy and northern Africa, it is considered atlantic-mediterranean.

Distribution maps have been published by HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962).

The species was found in The Netherlands by the S.O.L. investigators in the Guelders, Kempen, Drenthian and Subcentral European district, and by the present author in the Guelders, Kempen, Subcentral European and Wadden district. The species is mentioned from the Drenthian district by BARKMAN & WESTHOFF (1969); the species has disappeared there.

Apium inundatum reaches the highest presence degree and combined estimation in the Eleocharition acicularis and is therefore considered a character taxon of that alliance. It is also found in Littorelletea associations belonging to other alliances. The species can stand richer habitats than most Littorelletea species; this has been shown by SCHOONEN (1968) who observed the species in Phragmitetea and Potametea communities. The eutrophilic character of *Apium inundatum* also appears from the relevés of table 11 in the present work. The species was seen in water with a pH of 6-8.2

(once 9.6), and with an electrical conductivity of up to 300 μS, (in one case 510 μS). The highest Cl^- content measured was 79 mg/l, and the highest Ca^{2+} content 47 mg/l. *Apium inundatum* occurs in calcareous pools of The Burren in Ireland. Although it can stand a temporary terrestrial life, it is usually found in those parts of the shore that do not run dry in summer.

Apium inundatum used to occur on the border between the holocene and pleistocene part of The Netherlands, where it indicated seepage water from the latter region (WESTHOFF et al. 1971). According to IVERSEN (1936) the species is an amphiphyte.

Deschampsia setacea

This species is found in western Spain, south western France, Brittany and Loire basin, north eastern Belgium, southern and eastern Netherlands, north western Germany, western Denmark, southern Sweden, northern and eastern Scotland, southern and eastern England, Galway. and Lausitz (south of Berlin). DUPONT (1962) considers the species euatlantic, almost subatlantic because it is found in Sweden and eastern Germany. Distribution maps are given by MEUSEL (1965), HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962).

In The Netherlands *Deschampsoa setacea* is found in the pleistocene region and in the Wadden district (Terschelling). It was observed by the S.O.L.investigators and by the present author only in the Drenthian, Subcentral European and the Kempen districts. The species has apparently disappeared from the Wadden and Guelders districts.

Deschampsia setacea is considered a character taxon of the Eleocharetum multicaulis by the present author. The habitat of the species is described in Flora Neerlandica I, 2 (1951) as „moorland pools with fluctuating water level, clear water on oligotrophic, unfertilized sand and in wet dune valleys".

The species was observed by the present author on sand, sand covered with mud or organic matter and peat. Many sites run dry in summer, but some keep a water level of up to 30 cm. The water is usually poor in nutrients: pH 4.2-6.5, electrical conductivity 75-120 μS, 10-40 mg Cl^-/l, 3-15 mg Ca^{2+}/l In some stands an electrical conductivity of 200-300 μS was measured and 80 mg Cl^-/l.

Echinodorus ranunculoides

This species is found in the hole of the atlantic region and in a large part of the mediterranean region: southern Portugal, northern Africa as far as Libanon, Italy, Yugoslavia, Greece and the Canaries. DUPONT (1962) considers the species atlantic mediterranean rather than mediterranean atlantic. Distribution maps are presented by MEUSEL (1965), HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962).

In The Netherlands the species occurs in the Drenthian, Guelders, Subcentral European, Kempen, Wadden districts rather frequently, and occasionally in the Dune, Flemish and Haff districts. It was observed by the S.O.L.investigators in the Drenthian, Guelders, Subcentral European and Kempen districts and by the present author in the Guelders, Subcentral European, Kempen and Wadden districts.

Echinodorus ranunculoides is considered a character taxon of the Eleocharition acicularis; it has the highest presence degree and combined estimation in this alliance, but it is trangressive in other syntaxa of the Littorelletalia as well.

The species is usually found in pools that are slightly enriched with nutrients, such as a dune valley on the island of Terschelling (pH 7.7, electrical conductivity 372 μS, 80 mg Cl^-/l, 57 mg Ca^{2+}/l). The species was observed in Ireland in The Burren and in Lough Ree, both with calcareous soils; in the same country it was observed in a very oligotrophic habitat (pH 7, electrical conductivity 60 μS, 11.7 mg Cl^-/l and 1.7 mg Ca^{2+}/l).

The soil usually is sand covered with mud, but pure sand as well as thick layers of mud are also noted. Most sites run dry in summer. *Echinodorus ranunculoides* was observed with leaves 60 cm in length in a dune pool in France.

The species is seen to offer strong resistance to water pollution in some pools, for instance in „De Banen" at Weert and „de Schaapsloop" at Valkenswaard.

The species is considered an amphiphyte by IVERSEN (1936).

Echinodorus repens

Many authors do not distinguish this species *Echinodorus ranunculoides*; W. Diemont and G. Sissingh, whose relevés are rendered in the present work, are among them.

Echinodorus repens is not mentioned by MEUSEL (1965), HULTEN (1950), PERRING & WALTERS (1962) or DUPONT (1962). VAN ROMPAEY & DELVOSALLE (1972), however, give a distribution map for the species.

KERN & REICHGELT (1950) have elucidated the differences between *Echinodorus ranunculoides* and *E. repens*, and they have specified the

Echinodorus repens from the Beuven at Someren, North-Brabant. Photo by E.E. van der Voo.

localities of both species. It appeared that *E. repens* has only been found in the Kempen district; the investigations of the S.O.L. and of the present author have confirmed this area.

The distribution of the species in Europe is incompletely known. CHRISTIANSEN (1953) mentioned the species (under the name *Echionodorus ranunculoides* var. *repens*) from Schleswig-Holstein; it is mentioned from Belgium by MULLENDERS (1967) and from France by several authors: GADECEAU (1909), CHOUARD (1925), RALLET (1935) and JOVET (1951). The species is not known from the British Isles. *Echinodorus repens* apparently has an atlantic distribution.

The species is considered a character taxon of the Eleocharetum multicaulis. It is usually found on sand which in some stands is covered with mud. It was observed on loamy sand in one locallity. The soil usually runs dry in summer.

The water is not too poor in most cases, but values such as pH 9.95, electrical conductivity of 313 μS and 79 mg Cl^{-}/l are an exception.

Echinodorus repens is an amphiphyte in the sense of IVERSEN (1936).

Eleocharis acicularis

This species occurs in almost the whole of Europe, except in the southern part and in the greater part of Russia. Outside Europe it is mentioned from North America and Australia.

Distribution maps are given in HULTEN (1950), who considers *Eleocharis acicularis* a boreal circumpolar species, and in VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962). The species is known from the whole of The Netherlands, except from the province of Zeeland and the dunes. It was not observed by the S.O.L. investigators, whereas the present author found it in the Kempen and Fluviatile districts.

Eleocharis acicularis is considered a character taxon of the Eleocharetum acicularis. It is found on all kinds of substrates, such as loam, clay and sand, and in oligotrophic to eutrophic waters. (pH 7-9.95, electrical conductivity 41-274 μS, 4.6-41 mg Cl^{-}/l and 1-40 mg Ca^{2+}/l). The species is frequently observed in open spots in the vegetation, for instance where cattle graze. The occurrence of *Eleocharis acicularis* in Nanocyperion communities has been previously mentioned (V.4).

IVERSEN (1936) considers *Eleocharis acicularis* an amphiphyte.

Eleocharis multicaulis

This species is reported from western Tunisia, eastern Algeria, Morocco, the greater part of Portugal, atlantic Spain, the greater part of France, Corsica, Sardinia, northern and western Italy, the Azores, the British Isles, Belgium, The Netherlands, western Denmark, north western Germany and occassionally from eastern Germany and southern Scandinavia. According to DUPONT (1962) the species is subatlantic mediterranean.

Distribution maps have been published by MEUSEL (1965), HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962).

In The Netherlands *Eleocharis multicaulis* is rare in the Wadden, Drenthian, Subcentral European, Guelders, Kempen and Flemish districts, and absent in the remaining districts. Both the S.O.L. investigators and the present author have observed the species in the Kempen, Subcentral European, Drenthian and Guelders districts; moreover, the present author observed it in the Wadden district.

Eleocharis multicaulis is considered a character taxon of the Eleocharetum multicaulis; in western Ireland, however, it is also frequently observed in the blanket bog. The species does not tolerate a water depth of more than a 30 cm; the sites usually run dry in summer.

In most stands a distinctly acid pH was measured and a low electrical conductivity The concentrations of Cl^- and Ca^{2+} were also low In some stands, however, the values were high with values for pH 8 1, for electrical conductivity 377 μS, for Cl^- 79 mg/l and for Ca^{2+} 43 mg/l *Eleocharis multicaulis* was observed once in the calcareous region of The Burren

Eriocaulon septangulare

In Europe this species is found in western Ireland and some of the Inner Hebrides (PERRING & WALTERS 1962) It may be considered an amphi-atlantic species since it has its main distribution in North America However, LOVE & LOVE (1958) doubt whether the American species is identical to the European species, the chromosome numbers of the American species are 32 and 48, whereas the Irish species has 64 chromosomes In America no specimens with 64 chromosomes have been found For this reason DUPONT (1962) considers it a euatlantic species

Eriocaulon septangulare is considered a character taxon of the Isoeto-Lobelietum and of the Lobelio-Isoetion It is also a geographical differential taxon of western Ireland

This species was observed in a great variety of habitats water level from below the surface to 60 cm, soil gravel, sand, gravel and sand with mud, mud, peat, trembling bog and floating substrate, pH 5 4 7 5, electrical conductivity 60-265 μS, Cl 12-56 mg/l, Ca^{2+} 1-28 mg/l The water was not rich in nutrients in most cases, however

Eriocaulon septangulare has to be considered a limnophyte according to IVERSEN (1936), as are *Lobelia dortmanna* and *Subularia aquatica*

Hypericum elodes

This species is found in north and central western Portugal, ibero-atlantic Spain, the greater part of France, the greater part of Ireland, southern and south western Great Britain, parts of Italy, Belgium, The Netherlands, north western Germany Lausitz and the Azores DUPONT (1962) considers *Hypericum elodes* a subatlantic species

Distribution maps are given by VAN ROMPAEY & DELVOSALLE (1972), PERRING & WALTERS (1962) and WALTER & STRAKA (1970)

According to an I V O N distribution map (1905), the species has been found in the pleistocene part of the country The S O L investigators observed the species in the Drenthian, Guelders, Kempen and Subcentral European districts, the present author observed it in the Kempen, Subcentral European and Fluviatile districts

Hypericum elodes is considered a character taxon of the Eleocharetum multicaulis. The species is usually observed in stands that stay inundated the whole year, although it can stand a temporary terrestrial life. In disturbed habitats facies are formed, as is shown in V.2 sub IVb.

Hypericum elodes was observed in water with a pH of 3.7-7.7; an electrical conductivity of 88-377 μS; 1-45 mg Ca^{2+}/l and 7-79 mg Cl^{-}/l. The stands usually contain water; 100 cm was the greatest depth observed. The soils are weak in most cases: peat, mud, sand covered with a thick layer of mud or organic matter, and roots of *Eriocaulon septangulare*. A pure sand substrate was observed occasionally. In some Irish stands grazing was noted.

Isoetes lacustris

This species occurs mainly in Fennoscandia, western Ireland, Scotland, Wales, the Lake District of Great Britain, and in a number of scattered localities as far as the Pyrenees and Russia. DUPONT (1962) considers *Isoetes lacustris* a species which was improperly formed atlantic, because its main distribution is north of the atlantic area. The species is also found outside of Europe in Japan and in North America.

Distribution maps are given by MEUSEL (1965), HULTEN (1950), who considers the species boreal incompletely circumpolar, and in PERRING & WALTERS (1962). *Isoëtes lacustris* is not mentioned by VAN ROMPAEY & DELVOSALLE (1972), although the species occurs in Belgium (MULLENDERS 1967).

In The Netherlands the species is found in the Drenthian and Kempen districts, but the S.O.L. investigators and the present author have only observed it in the Kempen district.

Isoetes lacustris is considered a character taxon of the Isoeto-Lobelietum and of the Lobelio-Isoëtion, and a differential taxon of a subassociation of the Isoeto-Lobelietum. The species is very vulnerable to water pollution.

In The Netherlands the species was only observed in deep water (more than 1 m), but in Scotland and Ireland it was observed in 5-50 cm of water. Deeper water has not been investigated. The pH was circumneutral, the electrical conductivity usually showed low values: 51-140 (-200) μS. The water was poor in Ca^{2+} (1-9 mg/l), whereas 11-53 mg Cl^{-}/l was measured. There was a gravel or sand soil, occasionally with some mud.

IVERSEN (1936) considered *Isoëtes lacustris* a limnophyte, because the species accomplishes its whole life cycle under water.

Isoetes setacea

This species has its main European distribution in Sweden, Norway and Finland, scattered localities occur as far as away as Spain Outside Europe the species is found in China, Japan and North America

HULTEN (1950) consideres the species boreal montane in Europe, and boreal circumpolar in the whole of its area Distribution maps are also given by MEUSEL (1965), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962) The species is not mentioned from the Lake District and southern Scotland

In The Netherlands *Isoetes setacea* is only known from the Kempen district, where it was observed by the S O L investigators and the present author In VAN DE VEER (1956) a survey is given by all Dutch localities of *Isoetes setacea* and *I lacustris*

Isoetes setacea is, just as *Isoetes lacustris*, considered a character taxon of the Isoeto-Lobelietum and the Lobelio-Isoetion, and a differential taxon of a subassociation of the association

In the single Dutch locality the species was observed in acid water, 10-20 cm deep, on a loamy sand soil In Ireland and Scotland, however, the water was circumneutral and up to 60 cm deep The Ca^{2+} content of the water was low, but electrical conductivity (82-203 μS) and Cl^- content (14-41 mg/l) were more varied The species was observed on peat, gravel with mud and gravel with sand

As *Isoetes lacustris*, this species is considered a limnophyte by IVERSEN (1936)

Juncus bulbosus

This species is found in the greater part of Europe, as far as western Russia, it is rare in southern Europe Outside Europe it is known from Newfoundland, the Canaries and the Azores According to DUPONT (1962) *Juncus bulbosus* belongs to the group of species, which are wrongly considered atlantic

Distribution maps have been published by MEUSEL (1965), HULTEN (1950) who classifies *Juncus bulbosus* into the group of boreal incompletely circumpolar species, VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962)

In The Netherlands the species was known from the pleistocene part of the country and from dune valleys The S O L investigators observed it in the Guelders, Drenthian, Kempen and Subcentral European districts, whereas the present author observed it in the Wadden and Fluviatile districts as well

Juncus bulbosus is considered a character taxon of the Littorelletea. It has a great ecological amplitude, but it is most frequently observed in oligotrophic pools.

The pH is usually below 6, electrical conductivity below 140 μS, Ca^{2+} below 5 mg/l, and Cl^- below 20 mg/l. The water depth can reach more than 1 m, but *Juncus bulbosus* can also tolerate a terrestrial period. The species is observed on a great variety of soils: sand, loamy sand, sand with organic matter, peat, gravel with sand, and marl.

In some stands high pH, electrical conductivity, Cl^- and Ca^{2+} content are measured, especially in the dune pools and in The Burren. The most exceptional habitat was observed in Lough Meela, Co. Donegal, here *Juncus bulbosus* was growing in water with an electrical conductivity of 3669 μS, and the Cl^- content was 1306 mg/l. According to REDEKE (1932) the water of this site has to be considered mesohalinic.

IVERSEN (1936) classified *Juncus bulbosus* into the amphiphytes.

Littorella uniflora

This species occurs from north western Portugal, atlantic Spain, in western and central Europe as far as northern Italy, Sardinia, Silezia, Baltic States, The Azores and Fennoscandia. In southern Europe the distribution is atlantic, but it occurs too far north to be a true atlantic species (DUPONT 1962). HULTEN (1962) considers *Littorella uniflora* a subatlantic species, and he and VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962) have published distribution maps.

In The Netherlands the species occurs in the Wadden, Dune, Kempen, Subcentral European, Guelders and Drenthian districts, according to a distribution map published by I.V.O.N. (1905). The S.O.L. investigators observed the species in the Kempen, Subcentral European and Drenthian districts, whereas the present author observed it in the Wadden district as well.

Littorella uniflora is considered a character taxon of the Littorelletalia.

Although found in a great variety of habitats, *Littorella uniflora* is absent in highly oligotrophic pools. The pH of 3.95 and the electrical conductivity of 104 μS, which were measured in one pool containing stand of *Littorella uniflora*, are exceptional. In most stands the pH is 7 or higher, and the electrical conductivity usually exceeds 200 μS. The observed values for Ca^{2+} are 1-50 mg/l, and for Cl^- 5-1306 mg/l. *Littorella uniflora* can tolerate a terrestrial period perfectly well, but is also frequently seen in summer in water up to 60 cm deep. It only flowers when it is not inundated, however.

The soils usually are solid (sand, gravel, in some cases covered with a thin layer of mud), but *Littorella uniflora* has been seen once on a peat soil

The species occurs in the calcareous areas of Durness (Scotland) and The Burren Ireland (PRAEGER 1932/1933) DENNERT (1971) has studied the ecology of *Littorella uniflora* in the island of Terschelling

IVERSEN (1936) considers this species to belong to the amphiphytes

Lobelia dortmanna

The species is found in Fennoscandia, Poland, Ireland, western and northern Great Britain, western France, Belgium, The Netherlands and north western Germany This species cannot be considered an atlantic species, as it occurs too far north and east (DUPONT 1962) Distribution maps have been given by VAN ROMPAEY & DELVOSALLE (1972), PERRING & WALTERS (1962) and HULTEN (1950) The latter author considers *Lobelia dortmanna* a boreal incompletely circumpolar species

The species is known from the pleistocene regions of The Netherlands, according to an I V O N distribution map (1905) Both the S O L investigators and the present author have observed the species in the Kempen and Drenthian districts

Lobelia dortmanna is considered a character taxon of the Isoeto-Lobelietum and of the Lobelio-Isoetion

The species is usually observed in clear water with a low electrical conductivity and a circumneutral pH It does not occur in calcareous regions, such as The Burren in western Ireland In pools containing *Lobelia dortmanna*, the highest measured value of Ca^{2+} was 20 mg/l, and of Cl^{-} 50 mg/l

The species is usually found on a solid soil, but sometimes a layer of mud rests on the sand This is not disastrous for *Lobelia dortmanna*, if there is some water movement, preventing mud from covering the leaves permanently In most pools a water depth of 5-50 cm was noted, in Wastwater, in the English Lake District, *Lobelia dortmanna* was seen growing in 2 m of water, and its flowers almost reached the surface!

These ecological data correspond with those rendered by WOODHEAD (1951) Grazing has been mentioned in sites with *Lobelia dortmanna* by WESTHOFF (1969), it did not have a bad influence on the vegetation, apparently

IVERSEN (1936) includes *Lobelia dortmanna* among the limnophytes

Luronium natans

This species is found in Galicia in Spain, in western France, locally in Great-Britain, in Belgium, The Netherlands, the greater part of Germany, Denmark and northern Poland. Isolated localities occur farther east. DUPONT (1962) does not consider *Luronium natans* an atlantic species, because of the eastern localities. Distribution maps are given by MEUSEL (1965), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962).

The Flora Neerlandica I, 6 (1964) mentions the species from the pleistocene part of The Netherlands and the Wadden and Dune districts. The S.O.L. investigators observed the species in the Drenthian, Subcentral European and Kempen districts, whereas the present author only found it in the Kempen district.

The species is considered a character taxon of the Littorelletalia in the present work.

Luronium natans is usually found in those parts of the shores of pools that do not run dry in summer. In The Netherlands it was observed in oligotrophic water; pH 4.1-6.4; electrical conductivity 100-137 μS, Ca^{2+} 5-15 mg/l; Cl^- 19-25 mg/l. In France, however, *Luronium natans* was found only once in an oligotrophic pool with a low pH and electrical conductivity. In most French pools the pH was higher than 7, up to 9.6; eutrophication had taken place by grazing or washing activities.

Luronium natans was usually observed on weak soils, such as sand with organic matter or mud; the water depth was 5-80 cm. This species has to be considered a limnophyte in the system of IVERSEN (1936).

Pilularia globulifera

This species is found in western Portugal, Galicia, western and central France, the greater part of the British Isles, northern Germany as far east as the River Oder, Denmark, southern Sweden, and southern Norway. It occurs in scattered localities in Finland, southern Germany, western Poland, northern Italy, and Yugoslavia. DUPONT (1962) considers this an atlantic, north western medio-european distribution.

Distribution maps have been published by MEUSEL (1965), HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962). HULTEN classifies *Pilularia globulifera* among the subatlantic species.

In The Netherlands the species has been mentioned from the pleistocene areas and from the Wadden district. The S.O.L. investigators observed the species in the Drenthian and Kempen districts, the present author in the Subcentral European and Kempen districts.

Pilularia globulifera is considered a character taxon of the Pilularietum globuliferae.

The species grows best in marshy places, on humid soils; it can tolerate a eutrophic habitat very well, if competition with tall species is not too strong. Therefore, the species is only found in those (complex) habitats, whre the tall plants are impeded in their development, for instance by grazing, treading or mowing. See also V.3.

Pilularia globulifera is an amphiphyte, according to IVERSEN (1936).

Potamogeton polygonifolius

The species is recorded from the atlantic region, the Azores, Madeira, north Africa, Italy, Yugoslavia, Balkan, Iran and Newfoundland. It is scattered in central Europe. DUPONT (1962) does not classify this species into the group of atlantic species.

BARKMAN & WESTHOFF (1969), however, consider *Potamogeton polygonifolius* an atlantic species.

In The Netherlands the species is recorded from the pleistocene region and from the Wadden district, according to an I.V.O.N. distribution map (1936). The S.O.L. investigators observed it in the Kempen and Drenthian districts, the present author in the Kempen, Guelders and Wadden districts.

Potamogeton polygonifolius is considered a character taxon of the Eleocharetum multicaulis. In the inland area it is usually found in acid, oligotrophic water, with pH 3.6-6; electrical conductivity 40-150 μS, 1-10 mg Ca^{2+}/l and 7-25 mg Cl^-/l. In the dune pools of the island of Terschelling, as well as in some Irish and Scottish stands, these values were higher.

Potamogeton polygonifolius does not stand a longlasting terrestrial life, but it can survive on a humid substrate, such as a *Sphagnum* cover. The species is frequently observed in streamlets, especially in France and Ireland. Grazing was noted in an Irish stand.

In The Netherlands the species seems to be disappearing from the Littorelletalia communities, probably due to the eutrophication of the pools. *Potamogeton polygonifolius* is nowadays found mainly in the very oligotrophic *Utricularia minor and Sphagnum* communities. This seems to be contradictory to the fact that *Potamogeton polygonifolius* occurs in meso- to eutrophic pools in the island of Terschelling; in the island, however, the eutrophication is caused by Ca and Cl, whereas in the inland pools it is caused by P and N.

Ranunculus ololeucos

This species has a scattered distribution split into four parts northern Portugal and western Spain, western France, southern Italy and Sicily, and Belgium, The Netherlands and north western Germany According to DUPONT (1962) the species may be considered subatlantic, but as the taxonomic problems concerning this species are not solved, the distribution diagnosis has to be accepted with some reserve

A distribution map has been published by VAN ROMPAEY & DELVOSALLE (1972)

In The Netherlands the species is recorded from the Drenthian, Subcentral European, Guelders, Kempen and Fluviatile districts, according to an I V O N distribution map (1905) The S O.L. investigators observed the species in the Kempen district only, the present author also noted it in the Fluviatile district

Ranunculus ololeucos is considered a character taxon of the Eleocharetum multicaulis in the present work

The ecology of this species is badly known During the present study the species was usually observed in acid water (pH 4 5-5) but pH-values of 7 were noted occasionally Both low and high values for electrical conductivity were measured (80-94 and 280-380 μS) The soils were solid, consisting of sand or sand covered with mud. The observed summer water depth was 0-50 cm When the soil runs dry, *Ranunculus ololeucos* develops into the terrestrial form

Scirpus fluitans

This species occurs in northern Portugal, atlantic Spain, western France, Belgium, The Netherlands, north western Germany, Denmark, southern Sweden, and the British Isles Outside Europe it is known from Asia (VAN STEENIS & RUTTNER 1932), South Africa (KILLICK 1958), Australia, Madagascar, New Zealand and other places According to DUPONT (1962) *Scirpus fluitans* is a good example of a pseudo-atlantic species

Distribution maps have been given by MEUSEL (1965), HULTEN (1950), VAN ROMPAEY & DELVOSALLE (1972) and PERRING & WALTERS (1962) In The Netherlands the species is rather common in the pleistocene area, and it is also recorded from the Wadden and Haff districts The S O L investigators observed the species in the Kempen, Drenthian and Subcentral European districts, whereas the present author also saw it in the Guelders district

Scirpus fluitans is considered a character taxon of the Eleocharetum multicaulis in the present work.

The species is found in a great variety of habitats, from oligotrophic to disturbed and rather strongly eutrophicated habitats. Water analyses of *Scirpus fluitans* pools gave values for: pH 4.5-9.0; electrical conductivity 80-400 μS; Ca^{2+} 1-28 mg/l and Cl^- 17-90 mg/l. All kinds of soils were observed: sand, sand covered with mud or organic matter, peat, mud, loamy sand and gravel. The water depths varied between 0 and 100 cm.

The frequent occurrence of *Scirpus fluitans* in disturbed habitats has been dealt with in V.2 sub IVa. Its preference for an ecocline habitat was also observed in an Irish pool, where *Scirpus fluitans* was found growing in a transitional zone of bog vegetation to aquatic vegetation (fig. 8). pH was measured in several locations of this site. It was 5.4 in the bog vegetation and it decreased gradually in the direction of the open water, (0.2 or 0.3 pH-units per meter). The pH in the centre of the pool was 6.7; this value decreased towards the shore. *Scirpus fluitans* was only found in a zone parallel to the shore, where the pH changed abruptly (0.6 pH-units within 0.5 m); this zone represented the border area between water and land.

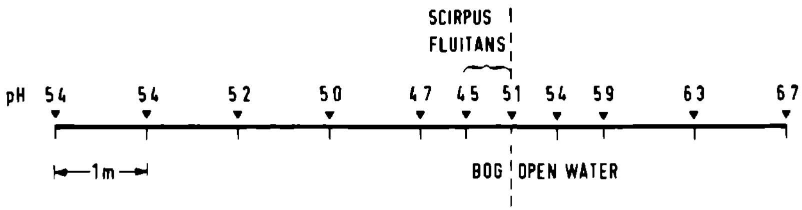

Fig. 8 pH-measurements from an Irish pool near Tullaghalaher Hill, Co. Galway.

Once a facies of *Scirpus fluitans* was observed in an apparently undistrubed, oligotrophic site at Driebergen. The pH, measured at two spots, was 5.8 and 6.2, and the electrical conductivity 93 and 100 μS. The vegetation consisted mainly of *Scirpus fluitans* with *Juncus bulbosus*; these species were growing in small ponds, local broadenings of a brooklet. The situation in the neighbourhood has not changed in the last 35 years (V. WESTHOFF, personal communication). It is not clear why no other Littorelletea species are found; a possible explanation is the fact that the pools are surrounded by trees, which intercept too much light for most Littorelletea species.

Subularia aquatica

This species is mainly found in Fennoscandia; scattered localities are reported from Ireland and Scotland to as far as the Pyrenees and the Balkans. Distribution maps have been given by MEUSEL (1965), VAN ROMPAEY & DELVOSALLE (1972), PERRING & WALTERS (1962) and HULTEN (1950). The latter author considers the species boreal incompletely circumpolar.

Subularia aquatica has been reported from The Netherlands, once, in 1881, in a pool of The Veluwe.

In the present work the species is considered a character taxon of the Isoëto-Lobelietum and the Lobelio-Isoëtion, and a differential taxon of one of the subassociations of the Isoëto-Lobelietum.

The species has been observed in circumneutral water, of 0-40 cm depth with a low electrical conductivity (60-82 μS). Ca^{2+} and Cl^- content were also low. The soils consisted of fine mud in most cases, which is in contrast with the soils reported by WOODHEAD (1951). More details about the soil are given by SCHOOF-VAN PELT & WESTHOFF (1969).

IVERSEN (1936) classified *Subularia aquatica* among the limnophytes.

Chapter VII

IMPOVERISHMENT OF FLORA AND VEGETATION OF MOORLAND POOLS IN THE NETHERLANDS DURING THE LAST 35 YEARS

The scope of the investigation as explained in Chapter I, is twofold
1 a comparative phytosociological investigation of the vegetation types of oligotrophic and mesotrophic moorland pools and similar waters in The Netherlands and adjacent regions
2 a study of the changes in the flora and vegetation of these pools during the last 35 years in The Netherlands

The first topic has resulted in a description of the syntaxonomy, synecology and synchorology of the syntaxa which can be classified into the Littorelletea They have been treated in an elaborate study which is rendered in Chapter V
The second part of the study, the changes in flora and vegetation, will be dealt with in this Chapter

The vegetation of moorland pools has not remained unchanged during the last 35 years Man has caused a levelling down of the landscape by activities such as re-allotment water pollution, air pollution, increasing application of artificial fertilizers, drainage, lowering of the water level, use of herbicides, mass recreation, expansion of industry These interventions have exercised their influence on the vegetation After ages of comparative rest the moorland pools became submitted to an increased temporal variation (disturbance), which expressed itself as eutrophication Most species characteristic of moorland pools cannot tolerate eutrophic conditions, or cannot compete with eutrophilic species It is therefore clear that the original vegetation of moorland pools impoverished or else disappeared completely
Changes in the vegetation and flora shall be dealt with on the basis of the Isoeto-Lobelietum, the Eleocharetum multicaulis and some other associations

VII 1 Isoeto-Lobelietum

In 1936-1943 the Isoeto-Lobelietum was known from 26 localities, in 1957-1959 from 17 localities, and in 1968-1970 from 6 localities. Only those pools represented by releves are taken into account. The character taxa of this association, *Lobelia dortmanna*, *Isoetes lacustris* and *I. setacea*, are usually inundated the whole year, and are therefore more susceptible to eutrophication, as opposed to the remaining Littorelletalia associations, which run dry in summer. The eutrophicating influence is greatest in summer, when nutrients are concentrated due to greater evaporation of water.

In the Huisvennen at Boxtel *Isoetes lacustris* was only mentioned in 1957 (table 2, releves 17 and 18), the species was not found by the present author, nor was it mentioned by G. Sissingh (table 1, rel. 1). *Lobelia dortmanna* still occurred in the pools in 1968, as was concluded from its leaves washed ashore.

The Allemansven at Oisterwijk contained *Lobelia dortmanna* and *Littorella uniflora* in 1943 (table 1, rel. 2), in 1957 and 1969 *Lobelia dortmanna* was not observed. *Littorella uniflora* was noted in 1957, but not observed in 1969.

In the Diaconieven at Oisterwijk *Lobelia dortmanna* was reported in 1943 (table 1, releves 3 and 21), of the Littorelletea species found then (table 1, releves 3 and 32) only *Littorella uniflora* was observed in 1957.

The Roevender Peel (table 1, rel. 4) and the Heelder Peel (table 1, releves 5 and 8) are probably lost as pools for Isoeto-Lobelietum communities.

In De Banen *Lobelia dortmanna* and *Isoetes setacea* were found in 1942 (table 1, rel. 6) in 1957 *Lobelia dortmanna* and *Isoetes setacea* were not observed, but *Apium inundatum*, *Echinodorus ranunculoides*, *Juncus bulboses*, *Littorella uniflora*, *Luronium natans* and *Myriophyllum alterniflorum* were still present, in 1967 only *Echinodorus ranunculoides* and *Scirpus fluitans* were observed.

De Leegde, once a pool containing *Isoetes setacea* (table 1, rel. 7), does not exist any more.

In the Beuven at Someren *Lobelia dortmanna*, *Isoetes lacustris*, *Luronium natans*, *Littorella uniflora* and other Littorelletea species were observed in 1942 (table 1, releves 9, 12, 14, 16 and 18), in 1957 *Lobelia dortmanna*, *Luronium natans* and *Littorella uniflora* were still present (table 2, releves 3, 32, 33 and 35), in 1968 *Lobelia dortmanna* and *Littorella uniflora* were observed (table 3, releves 2, 10-15). The Isoeto-Lobelietum, and in general the Littorelletea communities are currently restricted to a small part of the pool; the greater part is overgrown with reeds, due to the eutrophication by the Peelrijt, transporting sewage from the village of Someren.

The Isoeto-Lobelietum, observed in the Galgenven at Valkenswaard in 1943 (table 1, relevés 10 and 17), was still present in 1957 (table 2, relevés 5, 6, 9 and 23). The reed vegetation had expanded strongly in that time. The pool was not visited by the present author.

In the Staalbergven at Oisterwijk in 1943 a relevé was made of the Isoeto-Lobelietum, with *Lobelia dortmanna, Isoëtes lacustris* and *Littorella uniflora* (table 1, rel. 11). The same species were observed in 1957, but no relevés could be made with both *Isoetes lacustris* and *Lobelia dortmanna* (table 2, relevés 1 and 4). The present author observed the same species in 1968, but they had become very rare. Only a few specimens of *Lobelia dortmanna* were found, and a few leaves of *Isoetes lacustris* had been washed ashore.

The locality of the Isoëto-Lobelietum in the Smalle Eester Zanding at Drachten (table 1, rel. 13) is probably lost.

The situation in the Galgenven at Berkel has not changed much. *Littorella uniflora* and *Lobelia dortmanna* were observed in 1943 (table 1, rel. 15), in 1957 (table 2, relevés 24 and 25) and in 1968 (no relevés). *Isoetes lacustris* was noted in 1943 and 1957 only, but it may still occur in the pool.

The locality of the Isoeto-Lobelietum of the Bankven at Goirle (table 1, rel. 19) is probably lost.

Isoeto-Lobelietum was observed in the Petersven at Valkenswaard in 1943 (table 1, relevés 20, 41 and 42) and in 1957 (table 2, rel 2) In 1968 however, *Lobelia dortmanna* had disappeared, and *Littorella uniflora* had become very rare in the pool.

The Isoeto-Lobelietum has disappeared from the pool east of Elsloo (table 1, rel. 22).

The Isoeto-Lobelietum was observed in the Ganzenpoel at Diever in 1936 (table 1, rel. 23) and in 1959 (table 2, rel. 30). In 1967 it had apparently disappeared.

The pool in the Strengeveld at Losser contained Isoèto-Lobelietum in 1939 only (table 1, rel. 24). *Littorella uniflora* was still present in 1957; it was not seen in 1968 any more.

Lobelia dortmanna and *Littorella uniflora* were observed in a pool in the Lattropse Veld at Denekamp in 1939 (table 1, relevés 27 and 39) *Littorella uniflora* was still present in 1958. The site disappeared after 1958, due to re-allotment.

The Isoeto-Lobelietum of the Usselerveen at Enschede was observed in 1939 (table 1, rel 30), but not in 1958 or 1969, *Littorella uniflora* and *Lobelia dortmanna* have disappeared

The Isoeto-Lobelietum site east of Haaksbergen (table 1, rel 31) has disappeared.

Lobelia dortmanna was observed in the Diaconieven at Oisterwijk in 1943 (table 1, rel 32), the species was no longer observed in 1957

The Isoeto-Lobelietum has completely disappeared from the Hazenputten at St Oedenrode after 1943 (table 1, rel 33)

The pool south of the Noordervaart at Helden contained Isoeto-Lobelietum in 1942 (table 1, releves 34 and 37) It is no longer observed in the pool

Lobelia dortmanna, Juncus bulbosus and *Littorella uniflora*, observed in the Flaas at Hoge en Lage Mierde in 1943 (table 1, rel 38), were also observed in 1957 (table 2, rel 13) and in 1970 (table 3, rel 3)

In the Brugven at Valkenswaard Isoeto-Lobelietum occurred in 1943 (table 1, rel 39), however, it was not observed there in 1957

Isoeto-Lobelietum was observed in the Schaapsloop at Valkenswaard in 1943 (table 1, rel 40) It was not noted in 1957 or in 1968 A rubbish-heap in the close vicinity of the pool has caused eutrophication of the water, and this may be responsible for the disappearance of *Lobelia dortmanna* and other species

VII.2 Eleocharetum multicaulis

The impoverishment of the Eleocharetum multicaulis appears from the fact that those subunits, which are richest in association character taxa, are represented only or mainly in table 7, with releves of W Diemont and G Sissingh from the years 1936-1943

The variant Ia of the association, with *Potamogeton polygonifolius* and *Scirpus fluitans*, is seen in ten releves of table 7, whereas in table 9 (period 1968 1970) it occurs in one releve only

The variant with *Scirpus fluitans* of the subassociation of *Littorella uniflora* (IIa) is only represented by releves of W Diemont and G Sissingh, whereas it is not represented in more recent releves from The Netherlands

The Eleocharetum multicaulis has completely disappeared from many localities the IJsbaan at Steensel (table 7, rel 34), the Van Esschenven at Oisterwijk (table 7, rel 6) the Witte Loop at Heeze (table 7, rel 8), the pool near Venrode at Boxtel (table 7, rel 2), the Volther Beld at Denekamp (table 7 releves 1 and 4), the Ageler Veld at Denekamp (table 7, releves 9, 17 20 and 23), the Vossenbeld at Ambt-Delden (table 7, rel 16), the pool south of the Noordervaart at Helden (table 7 releves 22 and 24), probably also from the ditch at Diessen (table 7, rel 5), a moorland pool at Tubbergen (table 7, rel 32), a pool south of the Lemseler Beek at Weerselo (table 7, rel 7), the Drieschichter Veld at Tubbergen (table 7, rel 29), a pool along the canal from Almelo to Nordhorn at Rubbergen (table 7, rel 26), the Stepelosche Veld at Haaksbergen (table 7, rel 12), the Denekampse Veld at Haaksbergen (table 7, relevés 10 and 14), the pool along the Kerker Esch at Denekamp (table 7, rel 35) and the Oude Broek and Wiekermeden at Weerselo (table 7, rel 19)

The Eleocharetum multicaulis from the Schaapsloop at Valkenswaard was classified in 1943 into the subassociation of *Littorella uniflora*, typical variant, subvariant of *Deschampsia setacea* (table 7, releves 21, 25 and 27) In 1957 and 1968 *Littorella uniflora* and *Deschampsia setacea* had disappeared from this site, the relevés dating from those years were classified into the subassociation of *Scirpus fluitans* (table 8, releves 23 and 30, table 9, rel 25) or into the facies of *Scirpus fluitans* (table 8, rel 88, table 9, relevés 53 and 55)

In the Petersven at Valkenswaard *Dechampsia setacea, Ranunculus ololeucos, Hypericum elodes* and *Littorella uniflora* were present in the Eleocharetum multicaulis in 1943 (table 7, rel 28), in 1957 *Deschampsia setacea* and *Ranunculus ololeucos* had disappeared and in 1968 *Hypericum elodes* was missing too Some relevés from 1968 were classified into the impoverished variant of the impoverished subassociation (table 9, relevés 30 and 33) Only *Eleocharis multicaulis* is left from the Eleocharetum multicaulis which has been observed in 1941 in the Bergvennen at Denekamp (table 7, releves 13 and 31) *Deschampsia setacea, Hypericum elodes, Potamogeton polygonifolius* and *Scirpus fluitans* have apparently disappeared, as have *Apium inundatum, Echinodorus ranunculoides* and *Pilularia globulifera*

In the Veldsnijdersven or Lentinkven at Haaksbergen the Eleocharetum multicaulis has maintained itself during the years (table 7, rel 15, table 8, relevés 17, 18 and 39, table 9, relevés 9 and 12) *Ranunculus ololeucos* and *Scirpus fluitans* have disappeared from the pool between 1958 and 1969

In the Molenven at Weerselo *Hypericum elodes* and *Juncus bulbosus* were observed in 1958, *Apium inundatum, Eleocharis multicaulis, Potamogeton polygonifolius* and *Scirpus fluitans*, present in 1939 (table 7, rel 3), had disappeared.

The situation in the Winkelsven at Boxtel does not seem to have changed much A great number of character taxa of Littorelletea syntaxa was observed in 1943, 1958 and 1968-1970. Among them are *Deschampsia setacea, Pilularia globulifera, Ranunculus ololeucos, Littorella uniflora* and *Scirpus fluitans.* (table 7, relevés 11, 18, 30, 33; table 8, relevés 13, 14, 22; table 9, relevés 2 and 14). *Potamogeton polygonifolius* was the only species not observed by the present author.

Several of the pools were not visited by W. Diemont or G. Sissingh; comparisons can therefore only be made between 1957-1959 and 1968-1970.

The Rouwven at Erp contained, among others, *Eleocharis multicaulis* and *Potamogeton polygonifolius* in 1958 (table 8, rel. 34); these species were not observed in 1969 (table 9, rel 37).

In some cases the present author noted the same Littorelletea species as the S.O.L.investigators, although the number of individuals had decreased: the Leikeven (table 8, rel. 86 and table 9, rel. 35) and the Plakkeven (table 8, rel. 94 and table 9, rel. 57), both at Loon op Zand; the Witven at Oisterwijk (table 8, rel. 98).

Deschampsia setacea was no longer observed by the present author in the Leemputten at Ossendrecht (table 8, relevés 32, 89, 90, 100, 101 and table 9, relevés 22, 24, 28).

The pool south of Valkenswaard at the boarder with Belgium was found completely dry in 1968, and the moorland pool vegetation (table 8, rel. 16) had isappeared.

Deschampsia setacea has disappeared from the Eleocharetum multicaulis in a pool west of Ambt-Delden after 1958 (table 8, rel. 18). *Deschampsia setacea, Hypericum elodes* and *Littorella uniflora* disappeared from the pool in the Schijvenveld at Ambt-Delden (table 8, rel. 11 and table 9, rel. 34). The western Bergvennen at Lattrop have completely disappeared due to drainage (table 8, rel. 28), whereas pools in the North Deurningerveld (table 8, rel. 60) and the pool near Rammelhaar (table 8, relevés 26 and 87), both at Denekamp, have disappeared in a re-allotment.

In the Zwart Ven bij Het Stroot at Enschede *Juncus bulbosus* and *Eleocharis multicaulis* were the only Littorelletea species present in 1970 (table 9, rel. 50); in 1958 *Hypericum elodes, Ranunculus ololeucos* and *Scirpus fluitans* were still observed (table 8, relevés 25, 41, 42).

Deschampsia setacea and *Ranunculus ololeucos* have disappeared from the Kluenven at Hengelo between 1958 and 1969 (table 8, relevés 21, 31, 93 and table 9, relevés 18, 42).

The Teeselinkven at Neede in 1969 contained the same Littorelletea species as in 1958 (table 8, relevés 12, 24, and table 9, relevés 3, 11).

VII.3 Other associations

Eleocharetum acicularis

Eleocharis acicularis is found in two different habitats In moorland pools *Eleocharis acicularis* is accompanied by a number of Littorelletea species, whereas eutrophilic species are scarce Such habitats have been observed by W Diemont and G Sissingh in De Banen at Nederweert, The IJzeren Man at Weert, the Haanschoter Gat at Barneveld, the Roevender Peel at Weert and the Breklenkamper Veld at Denekamp The Eleocharetum acicularis does not occur any more in these sites, probably due to eutrophication and drainage The Beuven at Someren probably is the only current moorland pool habitat of the Eleocharetum acicularis

Eleocharis acicularis is also found in a more disturbed habitat, and even in a eutrophic habitat In that case few or no Littorelletea species are present, and *Eleocharis acicularis* is accompanied by eutrophilic species Examples of this type of habitat are found in outer marshes of rivers, clay pits and loam pits These habitats are still found at present, as appears from table 15 W Diemont and G Sissingh did not investigate this type of habitat, which is, consequently, not represented in their releves It is very likely, though, that *Eleocharis acicularis* did occupy this habitat at that time

Eleocharis acicularis fo *fluitans* is observed in habitats on the border of the pleistocene region and the Haff district It is then frequently accompanied by *Sparganium minimum* and *Scirpus fluitans* (MEIJER & DE WIT 1955, WESTHOFF & DEN HELD 1969)

Pilularietum globuliferae

The Pilularietum globuliferae has disappeared from all localities, where W Diemont and G Sissing had made releves One site with Pilularietum globuliferae, mentioned by the S O L investigators in 1959, was still present in 1968-1970, viz the Winkelsven at Boxtel The Pilularietum globuliferae is usually found in a complex habitat, as has been explained in V 3 Such habitats hardly occur in The Netherlands nowadays, due to the present levelling down of the landscape

VII.4 Conclusion

The comparisons have shown that in most cases the vegetation of moorland pools has become strongly impoverished or has disappeared completely during the last 35 years. Moreover, many pools have disappeared, primarily due to re-allotment and drainage. The deterioration of the habitat, caused by eutrophication in the wide sense, has truck all associations mentioned here. It appears from the comparison that the vegetation of moorland pools has been best preserved in the most isolated sites.

SUMMARY

In this thesis the results are given of a study of the vegetation of moorland pools and similar waters in The Netherlands and adjacent regions

The studied areas, The Netherlands, western France, Scotland, the Lake District in England and western Ireland, all have a more or less atlantic climate, it is characterized by high amounts of precipitation, most of it falling in summer and autumn, a relatively low mean annual temperature, a low temperature amplitude and a low number of days with frost

In The Netherlands, Artois and Les Landes the pools are situated in pleistocene or holocene sands, in Brittany, Scotland, the Lake District and Ireland the pools and lakes are situated in bedrock of Precambrian or Palaeozoic age The origin of the pools in The Netherlands is discussed in detail

Most studied communities are to be found in small, shallow pools with a sandy soil and a fluctuating water level Generally the water in these pools is poor in nutrients

The vegetation of the pools was studied with the methods of the Zurich-Montpellier School (Braun-Blanquet approach) The sample plot records or "releves" have been synthetized in syntaxonomical matrices, called "vegetation tables" Water analyses have been executed in a number of sample plots

The study was focused on those communities that are commonly regarded as belonging to the class Littorelletea Seven associations were represented in the releves made by the present author Their syntaxonomy, synecology and synchorology are treated in detail in Chapter V The Isoeto-Lobelietum is bound to clear, oligotrophic water and a sand soil, the vegetation stays inundated the entire year The Eleocharetum multicaulis is found in shallow, oligotrophic water on a sand soil which is covered with mud or organic matter in a number of cases Most stands run dry in summer The Pilularietum globuliferae is found in a complex habitat where the eutrophic and oligotrophic influences balance each other The Eleocharetum acicularis is found in open spots in, usually eutrophilic, vegetation The Samolo-Littorelletum occurs in pools of the coastal dune valleys The typical representatives of the Sparganietum minimi are found in deep peat cuttings with an organic soil and water which is

slightly enriched in nutrients Transitions between this association and Potametea communities are frequently encountered The Sphagno-Sparganietum augustifolii is found in deep, oligotrophic water on an organic soil, in sheltered sites Blowing sands are frequently observed in the vicinity of the stands

The associations have been arranged into three alliances, the alliances have been classified into two orders

In Chapter VI the distribution and ecology of some character taxa of Littorelletea syntaxa are treated

Chapter VII gives a survey of the improverishment of the flora and vegetation of moorland pools in The Netherlands during the last 35 years Comparisons were made with the aid of relevés made by W Diemont and S Sissingh between 1936 and 1943, and by S O L investigators between 1957 and 1959

In most moorland pools the characteristic vegetation either had completely disappeared or had become stronly impoverished Only in strictly isolated pools the vegetation had remained broadly the same

SAMENVATTING

In dit proefschrift worden de resultaten gepubliceerd van een vergelijkend vegetatiekundig onderzoek van de vegetatie van vennen en overeenkomstige wateren in Nederland en aangrenzende gebieden

Alle onderzochte gebieden (Nederland, West-Frankrijk, Schotland, het Lake District in Engeland en West-Ierland) hebben een atlantisch klimaat, met grote hoeveelheden neerslag, vooral in de somer en herfst, een relatief lage gemiddelde temperatuur, een lage temperatuur-amplitudo en een gering aantal vorst- en ijsdagen. De vennen in Nederland, Artois en Les Landes liggen in pleistoceen dekzand of holoceen stuifzand, de plassen in Bretagne, Schotland, het Lake District en Ierland liggen in gesteenten van precambrische of paleozoische oorsprong. Het ontstaan der vennen in Nederland wordt vrij uitvoerig besproken.

De meeste bestudeerde gemeenschappen komen voor in kleine, ondiepe plassen met een zandbodem en een wisselende waterstand Het water van deze plassen is in het algemeen voedselarm

De vegetatie van de plassen is bestudeerd volgens de methoden van de Braun-Blanquet School Van een aantal proefvlaktes zijn wateranalyses uitgevoerd

Het onderzoek heeft zich geconcentreerd op die vegetatie-eenheden, die gewoonlijk tot de klasse Littorelletea worden gerekend Zeven associaties uit deze klasse zijn vertegenwoordigd in de opnamen, die tussen 1968 en 1970 zijn gemaakt. Van deze associaties zijn de syntaxonomie, de synoecologie en de synchorologie uitgebreid behandeld in Hoofdstuk V Het Isoeto-Lobelietum is gebonden aan helder, voedselarm water en een zandige bodem, de vegetatie valt 's zomers niet droog Het Eleocharetum multicaulis komt voor in ondiep, voedselarm water op een zandige bodem waarop zich een laag slik of organisch materiaal kan bevinden De vegetatie valt gedurende een deel van het jaar droog. Het Pilularietum globuliferae wordt aangetroffen in een komplex milieu waar eutrofe en oligotrofe invloeden met elkaar in evenwicht zijn. Het Eleocharetum acicularis komt voor op open plekken in een, meestal eutrafente, vegetatie. Het Samolo-Littorelletum wordt aangetroffen in duinplassen langs de kust. De typische vorm van het Sparganietum minimi komt voor in veenplassen op organisch substraat, het water is meestal enigszins verrijkt De vegetatie valt 's zomers niet droog Overgangen tussen deze associatie en Potametea-gemeenschappen komen regelmatig voor Het Sphagno-Sparganietum angustifolii komt voor in diep, voedselarm water op organisch substraat In de nabijheid van de meeste plassen met deze associatie wordt stuifzand aangetroffen.

De associaties worden tot drie verbonden gerekend, deze verbonden zijn in twee ordes ondergebracht

In Hoofdstuk VI worden de verspreiding van de oecologie van een aantal kensoorten van syntaxa der Littorelletea behandeld

In Hoofdstuk VII wordt een overzicht gegeven van de achteruitgang van de flora en vegetatie van de nederlandse vennen gedurende de laatste 35 jaar De huidige flora en vegetatie zijn vergeleken met de flora en vegetatie uit vroegere tijden, met behulp van opnamen van W Diemont en G Sissingh uit de jaren 1936-1943, en met opnamen van de S O L onderzoekers uit 1957-1959 In de meeste vennen is de karakteristieke vegetatie of geheel verdwenen of sterk verarmd Alleen in zeer sterk geisoleerde vennen hebben flora en vegetatie zich grotendeeld onveranderd gehandhaafd.

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LEGEND TO THE TABLES

Table 1

Rel. nr.

1	Huisvennen, Boxtel, North-Brabant East shore, sand soil.
2	Allemansven, Oisterwijk, North-Brabant Sand soil with a thin layer of organic matter. Reeds growing on shore
3	Diaconieven, Oisterwijk, North-Brabant Sand soil.
4	Roevender Peel, Weert, Limburg Loam soil with weak top layer in centre of pool
5	Heelder Peel, Grathem, Limburg. South-east shore, sand with some organic matter.
6	De Banen, Nederweert, Limburg Sand soil.
7	De Leegde, Leveroy, Limburg. Loamy sand, locally covered with mud
8	As 5. Solid sand with some organic matter.
9	Beuven, Someren, North-Brabant Sand soil with a trace of mud
10	Galgenven, Valkenswaard, North-Brabant. North-west shore, white sand.
11	Staalbergven, Oisterwijk, North-Brabant. Sand soil.
12	As 9. North shore, sand soil.
13	Smalle Eester Zanding, Drachten, Friesland Sand soil.
14	As 9 Sand, mixed with some organic matter.
15	Galgenven, Berkel, North-Brabant. Sand soil.
16	As 9. Sand soil with some mud.
17	As 10. Sand soil.
18	As 9. Sand soil with organic matter.
19	IJsbaan Bankven, Goirle, North-Brabant. Sand soil
20	Petersven, Valkenswaard, North-Brabant Sand soil with thin layer of mud.
21	As 1. North-west shore, sand soil with locally some mud
22	Pool east of Elsloo, Friesland Sand soil.
23	Ganzenpoel, Diever, Drenthe Sand soil
24	Pool in Strengeveld east of Stroothuizen, Denekamp, Overijssel. Sand soil.
25	Bergvennen, Denekamp, Overijssel East shore, sand soil.
26	As 25
27	Pool in Lattropse Veld, Denekamp, Overijssel. East shore, sand soil.
28	As 27 Sand soil.
29	As 27.
30	Usseler Veen, Enschede, Overijssel East shore, sand soil with some organic matter
31	Pool in moorland, Haaksbergen, Overijssel. East shore, sand soil
32	As 3.
33	Hazenputten, St Oedenrode, North-Brabant
34	Pool south of the Noordervaart, Helden, Limburg Solid soil with weak top layer of mud
35	As 25 East shore, sand soil.
36	As 25 Sand soil with thin layer of organic matter.

37 As 34
38 Flaas, Hoge en Lage Mierde, North-Brabant Sand soil.
39 Brugven, Valkenswaard, North-Brabant. Sand soil
40 Schaapsloop, Valkenswaard, North-Brabant. Sand soil with thin layer of mud.
41 As 20. South-west shore, sand soil with thin layer of mud.
42 As 20. Sand soil with thin layer of organic matter.

Table 2

Rel. nr.

1 Staalbergven, Oisterwijk, North-Brabant. East shore, sand soil with some organic matter
2 Petersven, Valkenswaard, North-Brabant. Sand soil with thin layer of mud.
3 Beuven, Someren, North-Brabant Nort-west shore, sand soil with 5 cm of mud
4 As 1. East shore, sand soil with some organic matter
5 Galgenven, Valkenswaard, North-Brabant. Sand soil
6 As 5 Sand soil with thin layer of green algea.
7 Grote Huisven, Boxtel, North-Brabant East shore, sand soil.
8 Klein Aderven, Oisterwijk, North-Brabant. North shore, sand soil.
9 As 5. Sand soil.
10 As 7 East shore, sand soil.
11 Leikeven, Loon op Zand, North-Brabant East shore, sand soil
12 As 11. East shore
13 Flaas, Hoge en Lage Mierde, North-Brabant East shore, sand soil with some organic matter.
14 Groote Meer, Ossendrecht, North-Brabant South-west shore, sand soil
15 As 14 North-west shore, sand soil with some organic matter.
16 As 14. East shore of eastern pool, sand soil with some organic matter
17 As 7 Sand soil with 15 cm of organic matter.
18 As 7. Sand soil with 20 cm of organic matter
19 Galgenven, Berkel, North-Brabant North shore, sand soil
20 Bergvennen, Denekamp, Overijssel Sand soil with some organic matter.
21 As 20. North shore, sand soil.
22 As 20 North-west shore, sand soil
23 As 5. Sand soil with some organic matter
24 As 19. South-west shore, sand soil with thin layer of organic matter.
25 As 19. North-west shore, sand soil with thin layer of organic matter.
26 Keyenhurk, Oost-, West- en Middelbeers, Nort-Brabant. East shore, sand soil.
27 Het Siep, Gennep, Limburg. Sand soil
28 Keelven, Berkel, North-Brabant North-east shore, sand soil with thin layer of organic matter.
29 Kogelvangersven, Oisterwijk, North-Brabant. North-east shore, sand soil
30 Ganzenpoel, Diever, Drenthe. East shore, sand soil.
31 As 7 East shore, sand soil
32 As 3. North-east shore, sand soil.
33 As 3 North-east shore, sand soil
34 Taamven, Valkenswaard, North-Brabant. West shore, sand soil with thick layer of

organic matter

35 As 3 North-west shore, sand soil

Table 3

Rel. nr.

1	Karregat, Nuland, North-Brabant North-west shore, sand soil, pH 4 3, electrical conductivity 158 μS
2	Beuven, Someren, North-Brabant North-west shore, sand soil with thin layer of mud, el cond 176 μS, Ca^{2+} 11 mg/l, Cl^- 29 mg/l
3	Flaas, Hoge en Lage Mierde, North-Brabant Sand soil
4	Groote Meer, Ossendrecht, North-Brabant West shore, sand soil, pH 5 0, el cond 170 μS, Ca^{2+} 11mg/l, Cl^- 22mg/l
5	As 4 West shore, sand soil, pH 4 7, el cond 170 μS, Ca^{2+} 11 mg/l, Cl^- 22 mg/l
6	As 1 South shore, sand soil with thick layer of organic matter, pH 6 1, el cond 75 μS
7	Bergvennen, Denekamp, Overijssel Sand soil
8	As 1 North-west shore, sand soil, pH 4 3, el cond 158 μS
9	Taamven, Valkenswaard, North-Brabant North shore, sand soil with 30 cm of mud, pH 6 1, el cond 116 μS, Ca^{2+} 6 mg/l, Cl^- 22 mg/l
10	As 2 North-west shore, sand soil
11	As 2 North-west shore, sand soil with weak top layer
12	As 2 North-west shore, sand soil with thin layer of mud
13	As 2 North-west shore, sand soil with thin layer of mud
14	As 2 North-west shore, sand soil with thin layer of mud
15	As 2 North-west shore, sand soil with thin layer of mud

Table 4

Rel. nr.

1	Etang Blanc, Landes Sand soil (pH 7, el cond 140 μS, Ca^{2+} 4 mg/l, Cl^- 27 mg/l)
2	As 1 North shore
3	As 1 North shore, sand soil, pH 7 0
4	As 1 North shore, sand soil with some mud, pH 7 7

Table 5

Rel. nr.

1	Loch a'Ghriama, Sutherland Sand soil with some mud
2	As 1 Gravel with sand and some mud
3	Loch Merkland, Sutherland Gravel with sand

4 Little Langdale, Westmorland Organic soil, pH 6 6, el cond 40 μS, Ca^{2+} 1 9 mg/l, Cl^- 3 8 mg/l

5 Pool near Loch Merkland, Sutherland Gravel soil with some mud

6 Pool near Skerricha, Sutherland Sand soil, pH 7 3, el cond 116 μS, Ca^{2+} 2 1 mg/l, Cl^- 24 5 mg/l

7 Lough Hope, Sutherland Sand soil with some mud, pH 7 2, el cond 66 μS, Ca^{2+} 1 5 mg/l, Cl^- 13 7 mg/l

8 As 1 Sand soil with some mud, pH 7 2, el cond 51 μS, Ca^{2+} 1 0 mg/l, Cl^- 11 6 mg/l

9 Shore of river between Loch a'Ghriama and Lough Merkland, Sutherland Gravel with sand and mud, pH 6 7

10 As 3 Sand soil, pH 6 9, el cond 58 μS, Ca^{2+} 1 4 mg/l, Cl^- 11 mg/l

11 Lough More, Sutherland Gravel with sand, pH 7 1, el cond 68 μS, Ca^{2+} 2 0 mg/l, Cl^- 13 1 mg/l

12 Lough Stack, Sutherland Sand soil with thick layer of mud, pH 7 0, el cond 75 μS, Ca^{2+} 3 2 mg/l, Cl 13 mg/l

13 As 12 Sand soil with mud

14 Pool along the road Laxford Bridge Durness, Sutherland Gravel with sand, pH 7 1, el cond 83 μS, Ca^{2+} 1 5 mg/l, Cl 15 6 mg/l

15 Pool south of Tongue, Sutherland Sand and gravel soil with some mud

16 As 3 Gravel with sand

17 Pool east of Coldbackie, Sutherland Gravel and sand with some mud, pH 6 8

18 Pool east of Coldbackie, near River Allt an Dearg, Sutherland Gravel with sand pH 7 6, el cond 203 μS, Ca^{2+} 3 6 mg/l, Cl^- 40 8 mg/l

19 As 18 Sand soil with some mud, pH 7 6

20 As 18 Gravel with some sand

21 Pool west of Melvich, Sutherland Gravel and sand with some mud, pH 6 8, el cond 203 μS, Ca^{2+} 2 9 mg/l, Cl^- 43 5 mg/l

22 As 1 Gravel soil

23 Brotherswater, Westmorland Gravel with sand, pH 7 5 el cond 63 μS, Ca^{2+} 3 5 mg/l, Cl^- 7 0 mg/l

24 As 1 Gravel soil, pH 6 9

25 As 9 Weak mud soil, pH 6 4, el cond 65 μS

26 As 1 Sand soil with much mud

27 As 1 Sand soil with some mud

28 Pool along the road Laxford Bridge-Durness, Sutherland Gravel soil with organic matter

29 As 28 Gravel soil with organic matter, pH 6 2

30 As 18 Black mud soil, pH 6 0

31 Pool between Kingshouse Inn and Achallader, Argyll Gravel and sand with layer of mud, pH 5 3, el cond 45 μS, Ca^{2+} 1 1 mg/l, Cl^- 8 0 mg/l

32 Pool along the road Laxford Bridge Durness, Sutherland Mud soil, pH 6 1

33 As 18 Gravel and sand soil

34 As 32 Thick layer of mud

35 Pool near Lough Hope, Sutherland Thick layer of slimy mud

36 As 35 Thick layer of slimy mud, pH 8 0, el cond 252 μS, Ca^{2+} 5 5 mg/l, Cl^- 41 mg/l

37 As 35 Thick layer of slimy mud

Table 6

Rel nr

1 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway, Gravel and sand soil

2 Lough Beaghcauneen, Connemara, Galway Gravel soil, pH 7 2

3 Pool at Glenamoy Peat Exp Station, Galway Undisturbed blanket bog, floating soil, consisting of roots of *Eriocaulon septangulare*

4 Pool near Meenanalbany, The Rosses, Donegal Weak soil

5 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway Rocks with organic matter in between, pH 6, el cond 78 μS, Ca^{2+} 9 mg/l, Cl^- 30 mg/l

6 Lough Naweelaun, Connemara, Galway Pool in blanket bog with organic soil

7 Pool next to Lough Nawaugh, The Rosses, Donegal Gravel with thick layer of mud

8 Lough Anure, The Rosses, Donegal Gravel soil, pH 7 5

9 Lough Inagh, Connemara, Galway Gravel and sand soil

10 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway Organic soil, pH 7 0

11 Ballynahinch River, Connemara, Galway Mud soil

12 Lough Naskanniva, Galway Weak, organic soil, pH 6 0

13 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway Weak organic soil, pH 7 3

14 Courhoor Lough, Connemara, Galway

15 Lough north of Clifden, Connemara, Galway

16 As 4 Gravel soil with some mud

17 Slowly running water between Lough Inagh and Derryclare Lough, Connemara, Galway Gravel and sand ph 7 5

18 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway Black mud soil, pH 7 5

19 Lough Tanny, Connemara, Galway Gravel with thin layer of brown mud, pH 6 2

20 Ballynahinch Lake, Connemara, Galway

21 As 12 Weak organic soil, pH in footprints 5 4

22 Pool north-east of Newport, Mayo Organic matter, pH 7 1

23 Lough Creggduff, south of Roundstone, Connemara, Galway Sheltered site

24 Pool south of Westport, Mayo Gravel and sand soil, pH 7 2

25 Lough Delphi, Mayo Slowly running water, sand soil, pH 7 4

26 As 10 Organic soil, pH 6 9

27 Lough Nacung Lower, Donegal Weak soil, pH 7 2

28 As 14 Sand with some organic matter, pH 6 5, el cond 136 μS, Ca^{2+} 9 mg/l, Cl^- 53 mg/l

29 As 19 Gravel soil, pH 6 7, el cond 113 μS, Ca^{2+} 1 2 mg/l, Cl^- 26 1 mg/l

30 Lough Nafullanrany, The Rosses, Donegal Gravel soil, el cond 133 μS Ca^{2+} 1 3 mg/l, Cl^- 30 3 mg/l

31 As 27 Slowly running water, weak soil, pH 7 6, el cond 82 μS, Ca^{2+} 1 9 mg/l, Cl^- 13 9 mg/l

32 As 11 Mud soil

33 As 9 Peat soil, pH 7 0, el cond 60 μS, Ca^{2+} 1 7 mg/l, Cl^- 11 7 mg/l

34 As 20 Thick layer of mud

35 Doo Lough, Galway Gravel with fine mud, pH 8 0

36 As 20. Solid mud.

37 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway. Gravel and stones.

38 Pool south of Tullaghalaher Hill, Galway. Sand and gravel with some mud, pH 6.7.

39 As 14. Black mud covering sand.

40 Pool north-west of Lough Astickeen, Galway. Floating substrate consisting of roots of *Eriocaulon septangulare*, pH 5.9.

41 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway. Thick layer of organic matter.

42 As 4. Gravel soil with mud, pH 6.9, el. cond. 126 μS.

43 Pool north-west of Lough Nahoga, Galway. Black mud, pH 5.4.

44 As 14. Sheltered site.

45 As 43. Stones covered with thin layer of mud, pH 5.9.

46 As 10. Peat soil.

47 As 38. Gravel and stones covered with mud, pH 6.8, el. cond. 103 μS, Ca^{2+} 1.8 mg/l, Cl^- 22 mg/l.

48 As 41. Organic soil, pH 6.5, el. cond. 104 μS, Ca^{2+} 10 mg/l, Cl^- 37 mg/l.

49 Pool along "bogroad" between Clifden and Toombeola, Connemara, Galway. Stony soil, pH 6, el. cond. 81 μS, Ca^{2+} 4 mg/l, Cl^- 25 mg/l.

50 Brook, in connection with Lough Naskanniva, Galway. Brown mud, pH 5.6.

Table 7

Rel. nr.

1 Volther Veld, Denekamp, Overijssel. Moorland pool.

2 Pool at Venrode, Boxtel, North-Brabant. Loamy sand with layer of mud.

3 Molenven, Weerselo, Overijssel. Pool with much *Carex rostrata*.

4 As 1.

5 Ditch at Laaghorst, Diessen, North-Brabant. Wet soil.

6 Van Esschenven, Oisterwijk, North-Brabant. East shore, mud soil with organic matter.

7 Moorland south of the Lemseler Beek, Weerselo, Overijssel. Edge of moorland pool

8 Witte Loop between Grafven and Maasven, Heeze, North-Brabant. Grey sand, locally covered with thin layer of organic matter.

9 Ageler Veld, Denekamp, Overijssel. Moorland pool.

10 Man-dug pit south of the Goor, Soerendonk, North-Brabant.

11 Winkelsven, Boxtel, North-Brabant. Open spot in *Carex lasiocarpa* vegetation, south-west shore

12 Achterste Stepelosche Veld, Haaksbergen, Overijssel. Moorland pool.

13 Bergvennen, Denekamp, Overijssel

14 Denekampse Veld, Denekamp, Overijssel. Depression in *Erica tetralix* moorland.

15 Lentinkven (Veldsnijdersven), Haaksbergen, Overijssel. Moorland pool, dry in summer.

16 Vossenbeld, Ambt-Delden, Overijssel. Excavated spot in Caricetum curto-echinatae stand.

17 As 9 East shore, sand soil.

18 Ditch south of Winkelsven, Boxtel, North-Brabant.

19 Oude Broek and Wiekermeden north of Rossum, Weerselo, Overijssel. Humid depression in *Salix-Betula*-stand
20 As 9. Depression in *Erica tetralix* moorland.
21 Schaapsloop, Valkenswaard, North-Brabant. Mud soil.
22 Pool south of Noordervaart, Helden, Limburg. Adjacent to Isoeto-Lobelietum stand in deeper water.
23 As 9. Depression in stand of *Molinia caerulea* and *Myrica gale*
24 As 22. North-east shore, solid soil covered with 5 cm of mud.
25 As 21. Edge of pool which runs dry in summer.
26 Pool south of the Canal from Almelo to Nordhorn, Tubbergen, Overijssel.
27 As 21. West shore, thick layer of mud.
28 Petersven, Valkenswaard, North-Brabant. Mud soil.
29 Southern Drieschichter Veld, Tubbergen, Overijssel. Depression in stand of *Erica tetralix* and *Molinia caerulea*
30 As 11.
31 As 13 *Lysimachia vulgaris, Peucedanum palustre* and *Galium palustre* are penetrating from the edge
32 Moorland pool west of Albergen, Tubbergen, Overijssel.
33 Moorland pool near Winkelsven, Boxtel, North-Brabant. Shore of mesotrophic pool.
34 Skating-rink at Steensel, North-Brabant. Formerly a moorland pool.
35 Pool near Kerker Esch, Denekamp, Overijssel. Open spot in Scirpo-Phragmitetum stand.

Table 8

Rel. nr.

1 Vaarvennen, Valkenswaard, North-Brabant. Sand soil covered with 10 cm of organic matter.
2 Achterste Goorven, Oisterwijk, North-Brabant. Trembling bog of 45 cm thickness on sand soil
3 Grote Goorven, Oisterwijk, North-Brabant. 60 cm of organic mud on sand.
4 As 1. Sand soil with 10 cm of organic matter.
5 As 2. Sand soil with 15 cm of mud.
6 As 2. Sand soil with 15 cm of mud.
7 As 1. Sand soil covered with 60 cm of organic matter.
8 As 2 Sand soil covered with 10 cm of sandy mud.
9 As 1. Sand soil covered with 5-10 cm of organic matter.
10 As 1. Sand soil covered with 5-10 cm of organic matter.
11 Ven in Schijvenveld, Ambt-Delden, Overijssel. Excavated spot in moorland.
12 Teeselinkven, Neede, Guelderland Sand soil.
13 Winkelsven, Boxtel, North-Brabant. Sand mixed with organic matter on sand.
14 As 13 Sand covered with 5 cm of organic matter
15 As 1. Sand soil with organic matter.
16 Pool near the Belgian border, south of Valkenswaard, North-Brabant Thick layer of organic matter on sand
17 Lentinkven or Veldsnijdersven, Haaksbergen, Overijssel Sand soil.

18 Pool along the road Delden-Goor, Ambt Delden, Overijssel Sand soil covered with a mixture of organic matter and sand

19 As 17 Sand soil

20 Leemputten, Ossendrecht, North Brabant Sand soil with 5 cm of organic matter

21 Kluenven, Hengelo, Overijssel Organic matter on sand

22 As 13 Sand covered with 10-15 cm of organic matter

23 Schaapsloop, Valkenswaard, North Brabant Sand soil mixed with some organic matter

24 As 12 Sand soil

25 Zwart Ven bij Het Stroot, Enschede, Overijssel Sand soil covered with a mixture of sand and organic matter

26 Ven op Rammelhaar, Denekamp, Overijssel 15 cm of organic matter on sand

27 Petersven, Valkenswaard, North Brabant Sand soil covered with thin layer of mud and organic matter

28 Pools near De Smoes, Denekamp, Overijssel Sand covered with 30 cm of organic matter

29 Uilenven, Bergeyk, North Brabant Organic matter on sand

30 As 23 Sand covered with a mixture of sand and organic matter

31 As 21 Sand covered with organic matter

32 As 20 Organic matter on sand

33 Waschven, Valkenswaard, North Brabant Sand soil

34 Rouwven, Erp, North-Brabant At least 30 cm of organic matter on sand

35 Pool between Smallenberg and Krakeelsveld, Haaksbergen, Overijssel Organic matter on sand

36 Pools in Breklenkamperveld, Denkamp, Overijssel Organic matter on sand

37 As 12

38 Hoefsven, Waalwijk, North-Brabant Sand soil covered with thick layer of organic matter

39 As 17

40 As 12 Organic matter on sand

41 As 25

42 As 25

43 As 35

44 Langven, Best, North-Brabant Peaty sand on sand

45 As 44 Sand covered with thin layer of organic matter

46 Kleine Huisven, Geldrop, North Brabant Organic matter on sand

47 Henneven, Heeze-Leende, North Brabant 1 m of organic matter on loam

48 Flaas, Hoge en Lage Mierde, North-Brabant Sand covered with 8 cm of organic matter

49 Zwartven, Hoge en Lage Mierde, North-Brabant Organic matter on peat

50 Leikeven, Loon op Zand, North-Brabant Sand soil with 8 cm of organic matter

51 Wit Hollandsven, Oost-, West en Middelbeers, North Brabant Sand soil covered with 3 cm of organic matter

52 Keyenhurk, Oost-, West en Middelbeers, North-Brabant Sand soil with thin layer of organic matter

53 As 52 Sand covered with 2-3 cm of organic matter

54 Pool north of Uden, North-Brabant Thick layer of organic matter on sand

55 Groot Vlasroot, Veldhoven North Brabant Sand covered with 4 cm of decaying *Sphagnum* sp

56 Molenven, Waalre, North Brabant Organic sand

57 As 56 Organic sand
58 Mosven, Woensdrecht, North-Brabant Sand with 2 cm of organic matter
59 Pool near Almelose Brug, Ambt Delden, Overijssel Sand soil covered with 2-5 cm of organic matter
60 Pool in Noord Deurningerveld, Denekamp, Overijssel Sandy loam, covered with 5-10 cm of organic matter
61 Pool in Buurserzand, Haaksbergen, Overijssel
62 Ven in 't Zand, Haaksbergen, Overijssel
63 As 62
64 Pool in Witte Veen, Haaksbergen, Overijssel
65 Pool in Bentelerzijde, Hengelo, Overijssel
66 Sluitersdijkvennetje, Hengelo, Overijssel
67 Oortvennen, Losser, Overijssel Sand soil covered with 2 cm of organic matter
68 Pluismeer, Baarn, Utrecht Sand soil with 10 cm of organic matter
69 De Wijde Blik, Beilen, Drenthe Sand with thick layer of organic matter
70 Ganzenpoel, Diever, Drenthe Sand mixed with organic matter
71 Pool south of Snoekveen, Diever, Drenthe Sand mixed with organic matter
72 Grote Veen, Dwingelo, Drenthe Sand mixed with organic matter
73 Pool in Grolloerveld, Rolde en Westerbork, Drenthe Sand soil with top layer of organic matter
74 As 73 Sand soil with thick top layer of organic matter
75 Witte Meer, Opsterland, Friesland Sand soil with 2 cm of organic matter
76 Pools in Hoge Veluwe, Ede, Guelderland Sand soil with top layer of organic matter
77 Kempesflesch, Ede, Guelderland Sand soil covered with thick layer of organic matter
78 Smitsplas, Ede, Guelderland Sand soil with thin layer of organic matter
79 Pool in Zwolsche Bos, Heerde, Guelderland
80 De Kolk, Laren, Guelderland
81 Pool in Appelsche Heide, Nijkerk, Guelderland Sand soil covered with 5 cm of organic matter
82 As 81 Sand soil with thick layer of organic matter
83 Pool at St Walrickruine, Overasselt, Guelderland Sand mixed with organic matter
84 Pool east of Uiversnest, Overasselt, Guelderland Peat soil
85 Pool south-east of Alverna, Wijchen, Guelderland Sand soil covered with 5 cm of organic matter
86 As 50 Sand soil mixed with organic matter
87 As 26 Sand covered with 10 cm of organic matter
88 As 23 Sand mixed with organic matter
89 As 20 Sand with thin layer of organic matter
90 As 20 Sand with thin layer of organic matter
91 As 20 Sand with thick layer of organic matter
92 As 38 Sand with 10 cm of organic matter
93 As 21
94 Plakkeven, Loon op Zand, North Brabant Organic matter on sand
95 Baksven, Berkel, North-Brabant Organic matter on sand
96 As 2 Trembling bog of 70 cm thickness
97 As 38 Sand with thick layer of organic matter
98 Witven, Oisterwijk, North-Brabant Sand mixed with organic matter
99 Heiven, Oisterwijk, North-Brabant Sand covered with mud

100 As 20 Sand with 15 cm of organic matter
101 As 20 Sand covered with mud

Table 9

Rel. nr.

1 Ditch in property "de Utrecht" Hilvarenbeek, North-Brabant Sand soil with exsiccated plant remains
2 Winkelsven, Boxtel, North-Brabant Sand soil with weak top layer
3 Teeselinkven, Neede, Guelderland Sand mixed with organic matter on sand, pH 7 3, el cond 220 µS, Ca^{2+} 47 mg/l, Cl^- 27 mg/l
4 As 2 Sand with mud, pH 5 5, el cond 115 µS, Ca^{2+} 5 8 mg/l, Cl 9 9 mg/l
5 Beuven, Someren, North Brabant Sand soil with thin layer of mud
6 As 5 Sand soil with thin layer of mud
7 As 3 Sand with top layer of sand + organic matter
8 Wittes Venn, Altstatte, Germany Sand with top layer of 5 cm organic matter
9 Lentinkven, Haaksbergen, Overijssel Solid soil, pH 4 2
10 Groote Meer, Ossendrecht, North Brabant Sand soil with thin layer of mud, pH 4 5
11 As 3 Sand with 4 cm of organic matter
12 As 9 Solid soil, pH 3 95, el cond 104 µS, Ca^{2+} 4 0 mg/l, Cl^- 7 1 mg/l
13 Hoefsven, Waalwijk, North-Brabant Sand soil with 5-10 cm of organic matter
14 As 2 Thin layer of silt on sand
15 Pool at Nieuwkuijk, North-Brabant. Muddy sand
16 Leikeven, Loon op Zand, North-Brabant Sand with thin layer of mud, pH 4 4, el cond 128 µS, Ca^{2+} 5 mg/l, Cl^- 16 mg/l
17 Taamven, Valkenswaard, North-Brabant Mud soil
18 Kluenven, Hengelo, Overijssel Sand soil, pH 4 5
19 Pool between Smallenberg and Krakeelsveld, Haaksbergen, Overijssel Sand soil, pH 4 5, el cond 94 µS
20 As 8 Sand with thin layer of organic matter (pH 4 6, el cond 119 µS)
21 As 2 Sand with very thin layer of organic matter
22 Leemputten, Ossendrecht, North-Brabant Loamy sand, pH 6 5, el cond 100 µS, Ca^{2+} 11 mg/l, Cl^- 20 mg/l
23 As 13 Sand soil with 5 cm of organic matter
24 As 22
25 Schaapsloop, Valkenswaard, North Brabant Sand mixed with mud
26 Petersven, Valkenswaard, North-Brabant Sand soil
27 Rouwven, Erp, North-Brabant Slimy organic matter, pH 5 9, el cond 108 µS, Ca^{2+} 5 1 mg/l, Cl 13 mg/l
28 As 22 Solid soil
29 Pool south of the Hoefsven, Waalwijk, North-Brabant Sand with thin layer of organic matter
30 As 26 Thick layer of organic matter on sand
31 Baksven, Berkel, North-Brabant Organic soil, pH 3 8, el cond 204 µS, Ca^{2+} 5 0 mg/l, Cl^- 27 mg/l
32 Ossenkolk, Ermelo, Guelderland Organic soil, pH 4 0, el cond 119 µS

33 As 26 Sand with thin layer of organic matter, pH 4 6, el cond 46 μS, Ca^{2+} 6 mg/l, Cl 10 mg/l
34 Pool in the Schijvenveld, Ambt-Delden, Overijssel Organic soil, pH 4 6
35 As 16 Sand soil with thin layer of organic matter
36 Uiversnest, Overasselt, Guelderland. Sand with thick layer of organic matter
37 Malpievennen, Valkenswaard, North-Brabant Organic soil, pH 3 8, el cond 67 μS, Ca^{2+} 8 mg/l, Cl^- 7 4 mg/l
38 As 37 Organic soil, pH 3 6, el cond 105 μS, Ca^{2+} 7 mg/l, Cl^- 9 mg/l
39 Pool between Starven and Beuven, Someren, North-Brabant Thick layer of organic matter on sand, pH 3 5, el cond 97 μS, Ca^{2+} 6 mg/l, Cl^- 9 8 mg/l
40 As 37 Organic soil, pH 5, el cond 40 μS, Ca^{2+} 6 mg/l, Cl^- 11 mg/l
41 Groot Huisven, Boxtel, North-Brabant Sand soil with layer of mud
42 As 18 Weak soil, pH 4 1
43 As 41 Sand with 5 cm of organic matter
44 As 37 Solid soil with top layer of organic matter
45 As 41 Sand soil with thin layer of organic matter
46 As 37 Sand with top layer of mud
47 As 41 Thick layer of organic matter on sand
48 As 41 Thin layer of organic matter on sand
49 Pool at Gassel, North-Brabant Sand with thin layer of organic matter
50 Zwart Ven bij Het Stroot, Losser, Overijssel Sand soil with 10 cm of organic matter
51 Bultven, Deurne, North-Brabant Thick solid mud on sand
52 As 17 Sand soil with top layer of mud, pH 6 5, el cond 224 μS, Ca^{2+} 10 mg/l, Cl^- 26 mg/l
53 As 25 Sand soil with thin layer of mud
54 Loam pits at Staverden, Guelderland Thick layer of black mud on loamy sand, pH 7 4, el cond 134 μS
55 As 25 Sand soil with some cm of mud
56 As 54 Loamy sand covered with mud, pH 7 0, el cond 66 μS
57 Plakkeven Loon op Zand, North-Brabant Organic soil
58 Witven, Oisterwijk, North-Brabant Thick layer of organic matter on sand
59 As 13 30 cm of organic matter on sand
60 As 17 Weak mud

Table 10

Rel. nr.

1 Pool north of Carnac, Morbihan, Brittany Solid soil
2 Depression along the road from Ploemel to Erdeven, Morbihan, Brittany Muddy sand, (pH 6 4, el cond 313 μS, Ca^{2+} 4 2 mg/l, Cl^- 79 mg/l)
3 Pool south of Ploemel, Morbihan, Brittany Weak soil
4 Pool east of Paimpont, Vilaine, Brittany South shore, mud soil, pH 4 6
5 As 2 Solid soil
6 As 4 Mud soil, pH 4 5
7 As 4 Mud soil, pH 4 6, el cond 88 μS, Ca 1 3 mg/l, Cl 17 4 mg/l
8 Pool at Wardrecques, Pas-de-Calais Black mud soil

9 Etang de Soustons, Landes North shore, mud soil, pH 5 2

10 Etang Blanc, Landes North shore sand soil covered with thin layer of mud, pH 6 1, el cond 123 µS, Ca^{2+} 3 mg/l, Cl 25 mg/l Sample plot intersected by brooklets with temporary running water

11 Etang du Moulin Neuf, Cotes-du Nord, Brittany Sample plot north of the lake, around a brooklet with temporary running water

12 As 9 Weak soil, contact with eutrophic lake water

13 Pool north of etang de Leon, Landes Sand soil covered with thin layer of mud, pH 6 1, el cond 154 µS, Ca^{2+} 2 1 mg/l, Cl^- 34 mg/l

14 As 3 Weak soil

15 As 8 Black mud (nearby place pH 6 2, el cond 127 µS)

16 As 13 Sand soil with thin top layer of mud

17 As 3 Weak soil

18 As 1 Solid soil, organic matter suspended in water

19 Etang de Lacanau, Gironde East shore

20 Pool north-east of etang de Beaulieu, south-west of Dinan, Côtes-du Nord, Brittany Mud soil with footprints of cattle, pH 7 7

21 As 11 Sand soil with thin layer of mud

22 As 11 Sand with gravel

23 Etang de Beaulieu, Côtes-du-Nord, Brittany West shore, sand soil, covered with mud Near place where clothes are washed, pH 8 3

24 As 11 Sand soil covered with some mud

25 As 20 Sand soil with thin layer of mud

26 As 10 Sand soil, pH 7 1, el cond 141 µS, Ca^{2+} 4 1 mg/l, Cl^- 27 mg/l

27 As 1 Solid soil

28 As 19 East shore, sand soil, pH 7 2, el cond 166 µS, Ca^{2+} 2 4 mg/l, Cl^- 34 mg/l

29 As 4 Gravel and mud soil, pH 4 5, slowly running water

30 As 19 East shore, sand soil covered with thin layer of mud

31 Pool near étang de Lacanau, Gironde Sand soil covered with undecayed leaves, pH 6 3, el cond 155 µS, Ca^{2+} 2 3 mg/l, Cl 32 mg/l

32 As 3 Sand soil with thick layer of mud

33 Pool at La Feuillie, Manche Thick layer of mud on sand

34 As 2 Weak soil, pH 6 4, el cond 313 µS, Ca^{2+} 4 2 mg/l, Cl^- 79 mg/l

35 As 33 Sand soil with thick layer of mud, pH 5 5, el cond 119 µS, Ca^{2+} 0 9 mg/l, Cl^- 25 mg/l

36 Ditch north of étang de Hourtin, Gironde Weak soil, pH 6 0, el cond 280 µS, Ca^{2+} 3 5 mg/l, Cl^- 60 mg/l

37 Pool near Port Louis Morbihan, Brittany Sand soil

38 As 9 Mud soil

39 Pool near etang de Hourtin, Gironde Weak soil

40 Pool near Moliets, Landes Sand soil covered with mud, pH 7

41 As 8 Sand soil

42 Etang de Hourtin, Gironde pH 6 9

43 As 33 Thick layer of mud on sand

44 As 8 Weak soil, pH 6,2, el cond 127 µS, Ca^{2+} 4 5 mg/l, Cl^- 16 mg/l

45 Etang de Léon, Landes Turbid water, plants covered with green algae, pH 9 0

46 As 20 Sand soil

Table 12

Rel. nr.

1 Pool near Lough Shin, Sutherland Thick mud soil, pH 8 1
2 As 1 Thick mud soil, pH 6 1
3 Lough Stack, Sutherland Sand and gravel, covered with thin layer of mud
4 Pool near River Allt an Dearg, Sutherland Black mud
5 Pool at Sangobeg, Sutherland Black mud
6 Lough Hope, Sutherland Sand soil
7 Pool along the road from Laxford Bridge to Durness, Sutherland Slimy mud on peat soil

Table 13

Rel. nr.

1 Lough north of Clifden, Connemara, Galway
2 Lough Creggduff, south of Roundstone, Connemara, Galway Peat soil
3 Lough Bollard, north of Errisbeg, Connemara, Galway Pool in blanket bog
4 Trench in Bunowen Peninsula, Connemara, Galway
5 Pool east of Lough Naskanniva, Galway Stone soil, pH 7 7 Rubbish in pool
6 Ditch near Lough Naskanniva, Galway Organic mud
7 As 4
8 Humid depression in Bunowen Peninsula, Connemara, Galway
9 As 6 Brown mud, pH 5 6
10 Pool along "bogroad" from Clifden to Toombeola, Connemara, Galway Mud soil
11 As 8
12 Pool along road from Annagar to Loughanure, The Rosses, Donegal Gravel covered with mud, el cond 175 μS, Ca^{2+} 2 0 mg/1, Cl^{-} 39 mg/1
13 As 8
14 Pool along "bogroad" from Clifden to Toombeola, Connemara, Galway Rocks and gravel, pH 6, el cond 81 μS, Ca^{2+} 3 mg/1, Cl^{-} 25 mg/1
15 Pool at Bunowen Peninsula, Connemara, Galway Organic soil
16 As 12 Gravel with some mud, pH 6 6
17 Ballynahinch Lake Connemara, Galway Mud soil
18 As 17 Mud soil
19 Pool south of Tullaghalaher Hill, Galway Peat soil
20 Lough Glendallough, Wicklow Peat soil
21 Depression between Moyrush and Mace Head, Galway Rocks covered with mud
22 As 19 Peat soil, pH 5 2, el cond 138 μS, Ca^{2+} 1 mg/1, Cl^{-} 28 mg/1
23 Pool east of Meenanalbarg, The Rosses, Donegal Organic soil
24 Pool at Tullaghalaher Hill, Galway Gravel soil with some mud, pH 6 7, el cond 103 μS, Ca^{2+} 1 8 mg/1, Cl^{-} 22 mg/1
25 Pool north-west of Lough Nahoga, Galway Mud soil
26 Pool east of Lough Altercan, The Rosses, Donegal Organic soil (*Sphagnum* sp and roots of *Eriocaulon septangulare*)
27 As 22 Slowly running water, sand soil, algae growing on plants, pH 5 2

28 As 26 Organic soil, pH 6 3, el cond 123 µs

Table 14

Rel nr

1 Beuven, Someren, North-Brabant West shore, black mud soil with organic matter
2 Achterste Stepelosche Veld, Haaksbergen, Overijssel Ditch through moist meadow
3 Moorland, south of Canal from Almelo to Nordhorn, Tubbergen, Overijssel Ditch traversing Erica tetralix moorland
4 Ballinahinch River, Connemara, Galway Mud soil, visited by cattle Normally inundated
5 Ballynahinch Lake, Connemara, Galway Weak mud soil
6 Bestse Heide, Best, North Brabant In ditch draining moorland pool
7 Rossumer Veld, Weerselo, Overijssel Excavated pool, running dry in summer
8 Skating rink, Schijndel, North-Brabant Black mud, pH 5 9
9 De Hulshutte, Haaksbergen, Overijssel Sand soil of moorland pool
10 Depression along the road from Ploemel to Erdeven, Morbihan, Brittany Sand soil
11 Winkelsven, Boxtel, North Brabant Path, inundated in winter
12 As 12 Sand soil with top layer of organic matter (10 cm)
13 As 8 Mud soil covered with green algae
14 Doodemanskisten, Terschelling, Friesland
15 As 11 Sand covered with thin layer of organic matter Path, inundated in winter
16 As 11 Sand covered with thin layer of organic matter Path
17 As 8 Sand soil with thin layer of mud
18 Pool in Lonnekerveld, Enschede, Overijssel In contact zone between eutrophic water and oligotrophic sand pH 7 4, el cond 394 µS, Ca^{2+} 14 2 mg/1, Cl^- 39 mg/1
19 As 8 Solid soil, pH 6,1
20 Lattropse Veld, Denekamp, Overijssel 10 cm of organic matter on sand
21 As 8 Mud on solid soil, pH 7 0, el cond 377 µS, Ca^{2+} 18 4 mg/1, Cl^- 34 5 mg/1
22 Pool between Loudeac and Merdrignac, Côtes-du Nord, Brittany Clay soil Shore is treaded by anglers
23 As 22 Clay soil
24 As 22 Clay soil, pH 7 7, el cond 116 µS, Ca^{2+} 1 9 mg/1, Cl^- 19 3 mg/1
25 34 As 14

Table 15

Rel. nr.

1 De Banen, Nederweert, Limburg South east shore, moist soil
2 IJzeren Man, Weert, Limburg North west shore
3 Haanschoter Gat, Barneveld, Guelderland Open spots in *Phragmites australis* stand, 10 cm of organic mud on sand
4 Breklenkamper Veld, Denekamp Overijssel Ditch in moorland

5 Etang de Sagnat, Haute Vienne Sand soil, pH 7 0, el cond 41 µS, Ca^{2+} 0 9 mg/l, Cl^- 4 6 mg/l Site visited by cattle

6 Etang de Leon, Landes Sand soil with thin layer of mud, pH 7 0, el cond 149 µS, Ca^{2+} 1 8 mg/l, Cl 28 5 mg/l

7 Lough Carran, The Burren, Clare Marl soil with footprints of cattle

8 Lough Ree, Roscommon, Longford and Westmeath Sand with gravel and organic matter

9 As 8 Close to sewerage Soil covered with green algae

10 Roevender Peel, Weert, Limburg Organic mud

11 Beuven, Someren, North Brabant Sand covered with thin layer of mud

12 Wiel, Nieuwkuijk, North Brabant Sand with locally some organic matter

13 As 11 On flood-mark

14 As 11 Muddy sand

15 Leemkuilen, Udenhout, North Brabant Loamy sand

16 As 15 Loamy sand

17 Pool near étang de la Boule, Ille-et Vilaine, Brittany Mud soil

18 As 15 Loamy sand, pH soil water 8 3, pH surface water 9 95, el cond surface water 190 µS

19 As 15 Loamy sand, pH surface water 8 7, pH soil water 8 2, el cond 163 µS

20 As 15 Sand with thin layer of loam

21 As 15 Loamy sand, pH surface water 9 25, pH soil water 7 0, el cond surface water 206 µS, el cond soil water 274 µS

22 As 15 Loamy sand, pH surface water 9 8, pH soil water 6 8, el. cond surface water 205 µS

23 As 15 Sand soil with thick layer of organic matter, pH surface water 6 9, pH soil water 5 8, el cond surface water 142 µS

24 As 15 Loamy sand, pH 6 1, el cond 178 µS

25 As 15 Loamy sand

26 Pool near Orthen, North-Brabant Sand soil, locally covered with some brown mud

Table 16

Rel. nr.

1 Griltjeplak, Terschelling, Friesland Solid mud on sand

2 Depression near Kapeglop, Schiermonnikoog, Friesland Sand soil covered with some red mud

3 Van Hunenplak, Terschelling, Friesland Sand soil

4 As 2 Sand covered with brown mud

5 Pool in dune valley, Terschelling, Friesland Sand soil, pH 7 7, el cond 372 µS, Ca^{2+} 57 mg/l, Cl 80 mg/l

6 As 2 Sand soil with brown mud

7 As 2 Muddy sand on sand

8 Pool in dunes at Merlimont, Pas-de-Calais Sand soil covered with thin layer of organic matter

9 As 8 Sand soil

10 Pool in dunes between Vauville and Biville, Manche Sand soil with thin layer of mud

11 As 8 Sand soil covered with *Chara* sp, pH 7 3, el cond 316 μS, Ca^{2+} 13 5 mg/l, Cl^- 37 8 mg/l
12 As 8 Sand soil covered with some mud
13 As 10 Sand soil with thin layer of mud, pH 7 9, el cond 510 μS, Ca^{2+} 30 mg/l, Cl^- 47 mg/l
14 As 8 Sand soil
15 As 8 Sand covered with Chara sp and organic matter
16 As 10 Sand soil covered with some mud
17 Pool in Bunowen Peninsula, Connemara, Galway Gravel soil covered with organic matter
18 Lough Meela, The Rosses, Donegal Gravel soil, pH 7 5, el cond 3700 μS, Ca^{2+} 18 1 mg/l, Cl^- 1300 mg/l
19 Pool near Parkroe, east of Galway, Galway Marl soil, grazed
20 Pool east of Lough Bunny, The Burren, Clare Marl soil
21 As 20 Marl soil
22 Lough Bunny, The Burren, Clare Marl soil
23 Turlough near Knockaunroe, The Burren, Clare Marl soil with footprints of cattle, pH in footprints 8 1, el cond 400 μS
24 As 23 Marl soil
25 As 19 Marl soil
26 Pool near Caher Peak, east of Galway, Galway Marl soil, pH 9 1, el cond 343 μS, Ca^{2+} 17 6 mg/l, Cl^- 29 mg/l
27 Blackbrinck Bay of Lough Ree, Roscommon, Longford and Westmeath Marl soil covered with sand

Table 18

Rel. nr

1 Belversven, Oisterwijk, North-Brabant East shore
2 Van Esschenven, Oisterwijk, North-Brabant Trembling bog on east shore
3 Pool in Malpieheide, Valkenswaard, North-Brabant Shore of the pool
4 As 4 In the process of autogenic succession
5 As 1 Organic soil
6 Pool north of Zuid-Willemsvaart, North-Brabant Open spot in vegetation of *Cladium mariscus*
7 Allemansven, Oisterwijk, North-Brabant Mud soil between *Typha angustifolia* vegetation
8 As 1
9 Uilenven, Bergeijk, North-Brabant 40 cm of weak organic matter on sand
10 Pool in Schiphorster Heide, Valkenswaard, North-Brabant Sand soil with thick layer of organic matter
11 Pool south of Molenven, Valkenswaard, North Brabant In between reeds and sedges
12 Pool along the road Berghum-Mekkelhorst, Denekamp, Overijssel East shore, sand covered with some organic matter
13 Echelpool, Weerselo, Overijssel Depression in vegetation of *Carex vesicaria* and Hottonia palustris

14 Pool near Kerker Esch, Denekamp, Overijssel. Open spot in reed vegetation.
15 Teeselinkven, Neede, Guelderland. Sand covered with mixture of sand and organic matter.
16 As 15.
17 As 15. Organic matter on sand
18 Loam-pit, Staverden, Guelderland. Clear water.
19 Grote Goorven, Oisterwijk, North-Brabant. Thick layer of mud and organic matter
20 As 18 Probably constant water level
21 Ven op Rammelhaar, Denekamp, Overijssel. Thick layer of organic matter on sand.
22 As 2 Thick mud soil
23 As 2. Mud soil.
24 As 18. Sand soil, pH 7 65, el. cond 225 μS
25 De Banen, Nederweert, Limburg Solid soil, in reed vegetation.
26 As 25 Mud soil, in reed vegetation
27 Roevender Peel, Weert, Limburg. Organic matter on clay, open water in reed vegetation.
28 Brook between Meyel and Roggel, Limburg. Slowly running, canalized brook.
29 Witven, Oisterwijk, North-Brabant. Sand soil
30 As 29. Sand soil.
31 As 19. Muddy sand on sand.
32 As 29 Sand soil.

Table 19

Rel. nr.

1 Pool along road from Laxford Bridge to Durness, Sutherland Organic soil, pH 6.1, el. cond. 75 μS, Ca^{2+} 0 5 mg/l, Cl^- 16 5 mg/l.
2 Lough More, Sutherland Weak sand soil
3 Pool along road from Laxford Bridge to Durness, Sutherland Organic soil, pH 5 9.
4 Hazenputten, St Oedenrode, North-Brabant. Turbid water
5 Beuven, Someren, North-Brabant Muddy, organic soil
6 Groote Meer, Ossendrecht, North-Brabant South-west shore, sand soil, mixed with some organic matter.
7 As 4. Mud soil on sand.
8 As 6. Thin layer of organic matter on sand.
9 Pool in Bunowen Peninsula, Connemara, Galway. Gravel soil with thick layer of organic matter.
10 Ooster Zand, Uffelte, Drenthe.
11 Bergvennen, Denekamp, Overijssel. Thick layer of organic matter, west shore.
12 Brandeveen, Uffelte, Drenthe
13 Groote Veen, Dwingelo, Drenthe. West shore, thick layer of organic matter on sand
14 Ageler Veld, Denekamp, Overijssel. West shore, organic soil.
15 Anser Veld, Ansen, Drenthe

16 Diepenveen, Dwingelo, Drenthe South shore, thick layer of black organic mud on sand
17 Pool along road from Lissoughter and Maam Cross, Galway Organic soil
18 Peat hole in moorland, Gasteren, Drenthe
19 As 11 North-east shore, organic matter on sand
20 Lange Veen, Dwingelo, Drenthe West shore, thick layer of organic mud
21 Grensveen, Diever, Drenthe North shore, thick layer of organic matter on sand
22 As 11 Thick layer of organic matter on sand
23 Mosterdveen, Ermelo, Guelderland West shore, sand soil with thick layer of mud
24 As 21 Thick layer of organic mud on sand
25 Pool in Lheederzand, Dwingelo, Drenthe Sand mixed with organic matter
26 As 11 West shore, thick layer of organic matter
27 As 11 Thick layer of organic matter on sand
28 Pool along Doldersumseweg, Diever, Drenthe Sand mixed with organic matter.
29 As 28 South-east shore, thick layer of organic matter on sand
30 Brandeveen, Havelte, Drenthe South shore, organic matter mixed with sand
31 Zandveen, Dwingelo, Drenthe East shore, organic matter on sand
32 Snoekveen, Diever, Drenthe South shore, sand soil with some organic matter
33 As 11 Organic soil
34 As 11 10 cm of organic matter on sand
35 Pool south of Snoekveen, Diever, Drenthe Sand soil
36 As 35 Grey sand mixed with organic matter
37 As 6 Loamy sand
38 Kliplo-ven, Dwingelo, Drenthe Sand soil mixed with some organic matter
39 As 23 South shore, sand soil mixed with organic matter

Table 20

Column number

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3 table 5, relevés 8-16, table 6, relevés 23-25.
4 table 1, releves 4-8, table 2, relevés 14-16, table 3, relevés 4-5, table 5, relevés 17-20, table 6, relevés 26-27
5 table 1, relevés 9-18, table 2, relevés 17-18, table 5, relevés 21-24, table 6, relevés 28-30
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7 table 1, relevés 19-31, table 2, relevés 19-30, table 3, relevés 6-8
8 table 1, relevés 32-42, table 2, relevés 31-35, table 3, relevés 9-15, table 4, relevés 3-4, table 5, relevés 26-37, table 6, relevés 37-50
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26 table 15, relevés 18-23
27 table 16, relevés 1-27
28 table 18, relevés 1-11
29 table 18, relevés 12-15
30 table 18, relevés 16-20.
31 table 18, relevés 21-29.
32 table 18, relevés 30-33.
33 table 19, relevés 1-9
34 table 19, relevés 10-18.
35 table 19, relevés 19-29

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Dr Ir G. Sissingh and the late Dr Ir W H Diemont placed their unpublished relevés from 1936-1943 of Littorelletea communities kindly at my disposal

The Littorelletea releveés, which have been made between 1957 and 1959 by the S O L investigators, have been made available to me by the State Institute of Nature Conservation Research (now the Research Institute for Nature Management) Without these relevés it would have been difficult to interpret the present vegetation of moorland in The Netherlands, moreover, no comparison could have been made between the vegetation of the Dutch moorland pools at various times

I should like to thank Mr E E van der Voo (uncle Edouard) most warmly, his thorough knowledge of the sites to be studied and vegetation proved a valuable help His inspiring attitude and his cheerful character during many excursions are greatly appreciated

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CURRICULUM VITAE

De schrijfster van dit proefschrift werd geboren op 10 juni 1943 te Tilburg. Na de lagere school en het Gymnasium β te hebben doorlopen te Oss, begon zij in 1961 te Nijmegen met de biologie studie. In februari 1965 werd het kandidaatsexamen afgelegd. Tijdens de doktoraal studie is als hoofdvak gekozen botanie (bij Prof. Dr. A.L. Stoffers) en als bijvakken dieroecologie en didaktiek der biologie (resp. bij Dr. H.C.J. Oomen en Drs. F.J. van Oostrum). In februari 1967 werd het doktoraalexamen afgelegd.
Vanaf 1 februari 1967 tot 1 januari 1968 volgde een tijdelijke aanstelling aan het Botanisch Laboratorium te Nijmegen. In 1968 werd met het promotieonderzoek begonnen. Dit onderzoek werd tot juli 1970 gesubsidieerd door de Nederlandse Organizatie voor Zuiver-Wetenschappelijk Onderzoek. Voorzetting van het onderzoek werd daarna mogelijk gemaakt door een tijdelijke aanstelling aan de Katholieke Universiteit te Nijmegen als wetenschappelijk medewerkster.

ERRATA:

pag. 33, 57, 91, 103, 108, 123
PIETSCH (1965)
moet zijn:
PIETSCH (1965a)

pag. 91
V.3 Pilularietum globuliferae (Tüxen, ex Müller & Görs, 1960)
moet zijn:
V.3 Pilularietum globuliferae Tüxen ex Müller & Görs 1960

pag. 93
P.g. subularietosum aquatica
moet zijn:
P.g. subularietosum aquaticae

pag. 98
Loudeac
moet zijn:
Loudéac

pag. 128
V.6 Sparganietum minimi (Schaaf 1925)
moet zijn:
V.6 Sparganietum minimi Schaaf 1925

table 1

Isoeto-Lobelietum

The Netherlands

subunit number		Ib				III								IV											VI											VII						
releve number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	4	42
author	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	D	Si	Si	Si	Si	Si	Si	Si	Si	D	D	D	D	D	D	D	D	D	D	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si
year	43	43	43	42	42	42	42	42	42	43	43	42	36	42	43	42	43	42	43	43	43	36	36	39	39	39	39	39	39	39	39	43	43	42	41	41	42	43	43	43	43	43
quadrat size (m^2)				50	10	25	25	10	10				10	10	5	50	10	25	5	10	5			40	40	50	50	30	20	20	10		50	10					10	10	10	10
cover %				100	95	90	40 60	75	20		90			80	70	10	80	60	50 60	60	80												80 90	90		50	80		60	80	75	90
water depth (cm)	30	0 50	30 50	40	20 50	60 80	25 30	30	15 20	5 10	20 40		30 50	10	30 50	25	20 25	5		25 30	25		5 25	10 20								30	25	20	10 15		20	10 15			0 15	30
number of taxa	4	10	3	11	7	11	3	10	4	10	5	7	10	9	7	7	7	12	9	7	8	8	8	9	8	12	9	8	9	9	10	5	4	4	7	4	4	4	7	6	6	6
Character taxa of association and alliance																																										
Lobelia dortmanna	45	55	35	+2	44	23		12	21	22	45	21		23	34	11	22	22	11	34	34	+1	11	12	35	34	45	44	35	32	22	33	23	43	33	22	43	12	22	33	34	23
D Isoetes setacea				23	33	11	22	33																																		
D I lacustris									11		12	11	23	33	11	11		22																								
Character taxa of Eleocharetum multicaulis																																										
D Eleocharis multicaulis	(+)											+		+				+2		+2	12			12		22	+2				12	34	+1	12	+2	22	23	12	+2	+2	12	+2
Potamogeton polygonifolius																																				+2	(+)					+2
Hypericum elodes																		+			(+)									(+ 2)										(+)	+2	
Deschampsia setacea																														+2												
Character taxa of other Littorelletea syntaxa																																										
L D Luronium natans									+2	22		+2		12		12	22	12																								
L D Elatine hexandra										12		+		34		+2	12	23																								
Cl Juncus bulbosus	+2	12	12		12	+2	24	12		11	22	(+ 3)		12	12		+2	22	34	11	+2	22	22	32	34	23	23	35	33	44	33	12	33	+2	+2		+	22	12	12	+2	12
L Littorella uniflora	23	22			22	23		22	11	44	23		34		22	22	34	+	23	13	12	45	34	33	13	45	23	12	12	23	34		45	33	22	33	33	(+)	+3	34	23	34
E Echinodorus ranunculoides				33		13							11																													
A Eleocharis acicularis										23			23				12																									
E Apium inundatum				+																										+2												
A Sparganium angustifolium														+2				+2																								
A Pilularia globulifera																		12																								
Character taxa of Potametea																																										
Potamogeton pusillus												+2	11			+2																										
P natans				+2																																				+		
P gramineus		12				22																																				
Polygonum amphibium fo natans								+2																+2																		
Ranunculus aquatilis				+									21																													
Elodea canadensis				22									+1																													
Nymphaea alba		12																			(+)																					
Utricularia vulgaris		11																																								
Hydrocharis morsus-ranae						1ex																																				
Callitriche spec													12																													
Character taxa of Phragmitetea																																										
Eleocharis palustris ssp palustris					21			21		+				12	12			22							23	+2	12	24	22										21	11		
Glyceria fluitans																		1ex		+				+1						+2										(+)		
Carex rostrata								22													+2					+2																
Phragmites australis		13								+																					11											
Alisma plantago aquatica														+																												
Other phanerogamic companions																																										
Hydrocotyle vulgaris																			23			12	+1			+2			+3		+2											
Molinia caerulea																			12				+1																			
Eriophorum angustifolium																										12		12														
PL Myriophyllum alterniflorum		11		+		11																																				
Menyanthes trifoliata		+																																								
Carex lasiocarpa		22																																								
Agrostis stolonifera																						+2																				
Lemna trisulca						+2																																				
Bryophytes and algae																																										
D Sphagnum cuspidatum								+2		+					+2					23	12	12	12	44	33	33	23	33	33	44	44				+				12			
Drepanocladus fluitans				13	12		13	33					12		+2				12			33	+1	12	12	22	11	23	33	22	22											
D Sphagnum crassicladum			+2								+									+	33				23				12			33			+				+2			
D S inundatum																						34	44				22	34														
D S contortum																										34					23											
D S auriculatum																								12																		
D Gymnocolea inflata																									12	12	+2		+2													
Polytrichum juniperinum																			+2																							
Fontinalis antipyretica													12																													
Fossombronia spec																			12																							
Hygrohypnum palustre																																			+							
Sphagnum spec																			22											12	23											
Nitella spec				44		34																																				
filamentous algae	+2				12	22		33		12		+2				+	12				12											12						22			12	22

D = differential taxa of subassociations
Cl = character taxa of class Littorelletea
L = character taxa of order Littorelletalia
E character taxa of alliance Eleocharition acicularis
A character taxa of other Littorelletea associations
PL characteristic of both Potametea and Littorelletea

authors
Si G Sissingh
D W H Diemont

table 2

Isoeto-Lobelietum

The Netherlands

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
subunit number							Ib								III		IV							VI									VII		
releve number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
author (SOL)	G	vD	vD	G	vD	vD	G	G	vD	G	V	V	V	V	V	V	G	G	M	G	G	G	vD	G	G	V	P	G	G	V	G	vD	vD	vD	vD
year	57	57	57	57	57	57	59	57	57	59	57	57	57	57	57	57	59	59	57	58	58	58	57	59	59	57	58	59	57	59	59	57	57	57	57
quadrat size (m^2)	4	10	25	6	8	20	9	9	10	50	2	1	10	4	2	10	100	75	4	25	12	9	5	4	25	10	4	25	16	4	20	20	50	5	25
cover %	80	85	90	60	100	80	70	60	100	30	15	65	6	80	100	100	30-40	20	85	100	100	80	80	80	90	95	75	60	80	35	15	70	50	85	95
water depth (cm)	80	60	25-30	60-70	45-75	30-35	50	65	50-75	25-40	2	0	8	20	40-45	25	125	130	50	50	35-40	40	20-25	50-60	0-25	20	40	10-25	65	-	5-15	1-5	2- -	25-30	20
number of taxa	5	5	5	6	6	7	5	5	4	4	2	3	3	2	3	8	5	2	4	4	5	5	10	7	8	4	6	9	7	8	6	9	12	6	4
Character taxa of association and alliance																																			
Lobelia dortmanna	+ 1	2 1	1 2	3 2	2 2	4 5	4 5	1 2	4 5	3 5	2 2	1 2	1 2				1.2	.	3.2	r.1	3.2	3.4	+.2	4.5	1.2	1 2	2.2	2.2	2.2	1.2	2.2	2.2	1.2	2.3	4.3
D Isoetes setacea														4 5	1 2	+ 2			.		.				.		.		.	.	.	.	.	.	.
D I lacustris																	1 2	2 3	.		.		.					.	.	.	.	.	.	.	.
Character taxa of Eleocharetum multicaulis																																			
Eleocharis multicaulis																		.	.	.	.	.	.					.	+ 2	+.2	1.2	1.2	+.2	3.2	+.2
Echinodorus repens																	.	.	.	.	.	.	.		.	.	.	.	.	.	.	1.2	1.2	.	.
Ranunculus ololeucos																2 2		.	.	.	.	.		.					.		.		.	.	.
Hypericum elodes																	.	.	.	.	.	.	.	.	.			.	.	.	.	.	+.2	.	.
Character taxa of class and order																																			
Cl Juncus bulbosus	(+ 1)	3 2		3 2			+ 1	3 2		1 2	1 2	+ 2	1 2			4 5	1.2	(r.1)	+.2	.	.	.	+.2	1.2	1.2	2 2		2.3	2.2	1.2	2.2	(+)	+.2	1.2	.
L Littorella uniflora	4 4	1 2	4 3		4 4	2 2	+ 2		4 5	1 2		4 5			1 2	3 2	3.3	.		5.5	3.2	4.4	.	2.1	2.5	1.2	.	+ 2	.	2.2	1.2	3.3	2.2	2.3	4.3
L Luronium natans	1 2	+ 2	3 3	1 2	1 2													.	.	.	.	.	2 3			.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																																			
Eleocharis pal ssp palustris		+ 2	+ 2	+ 2	1 2	1 2	1 2										.	.	1.2	.	.	1.1	2 2	(r.1)	2.2	.	1.2	2.2	(+.1)	.	.	+.2	.	.	+.2
Carex rostrata					1 2	2 2			+ 2								.	.	.	.	.	.	2 2		.	.	.	.		.	.	.	.	+.2	.
Phragmites australis									1 2								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2.2	.	.
Carex hudsonii																	.	.	.	.	.	.	.	.		.	.	.	.	.	.	+.2	.	.	.
Alisma plantago-aquatica																	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	+.2	.	.
Iris pseudacorus																	.	.	.	.	.	.	+.2	.		.	.	.	.	.	.	.	.	.	.
Glyceria fluitans																1 2	.	.	.	.	.	.		.	.	.	1.2		.	.	.	.	.	.	.
Differentials of Agropyro-Rumicion crispi																																			
Hydrocotyle vulgaris																	.	.	.	.	.	.	+.2		.		.			.	.	.	+.2	+.2	.
Agrostis canina																+ 2	.	.	.		.		.				.			.	.	.	.	.	
Character taxa of Potametea																																			
Nymphaea alba																	.	(r k)		.	.	.			.			r k	.	.	.	.	.	.	.
Potamogeton natans			1 2														.	.	.	.								.	.		.	.	.		.
Other phanerogamic companions																																			
Lysimachia vulgaris						+ 1												.				.	+ 2			.							+.2	.	.
Carex lasiocarpa																														.		+.2	.	.	.
Molinia caerulea																													.		.	+.2	2.2	.	.
Carex serotina																															.	(+)	2.2		.
Peplis portula																5 5																		.	.
Bryophytes and algae																																			
Sphagnum crassicladum	1 2			1 2		1 2		1 2												3 2	3 2	2 2	3 2				+ 1		1 2	+ 2					
Drepanocladus fluitans														3 5	5 5	3 2				+ 2	+ 2	1 2	2 2	1 1	1 1			+ 1		r 1	.				.
D Sphagnum cuspidatum								1 2					+ 2						4 5					2 1	3 5	4 5	+ 1	2 2	4 4	+ 1					
D Cladopodiella fluitans																					+ 2			2 3	3 5			2 3		2 3	+ 2				
filamentous algae	x			x	4	4	x	x		x																			x						
Gymnocolea inflata																											4 4		2 2						
Sphagnum subsecundum																	1 2	2 2						+ 1	+ 1			2 2			+ 1				

D = differential taxa of subassociations
Cl - character taxon of class Littorelletea
L = character taxa of order Littorelletalia

authors
G P Glas
vD J v Donselaar
V F E v d Voo
M H Moller Pillot
P J H Peters

table 3

Isoëto-Lobelietum

The Netherlands

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	subunit number		Ib		III			VI					VII			
	relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	author	S	S	Wi	S	S	S	S	S	S	S	S	S	S	S	S
	year	70	69	70	69	69	70	69	70	68	68	68	69	68	68	68
	quadrat size (m^2)	6	4	10	2	4	1	1	4	2	2	1	4	2	2	1
	cover %	90	.	15	30	90	80	90	100	10	.	95	90	90	30	80
	water depth (cm)	15-30	50	.	20	10-15	15	-	20	30	15	20-30	2	5-10	10-20	-
	number of taxa	6	2	4	3	8	6	11	6	4	3	4	8	5	4	11
	Character taxa of association and alliance															
	Lobelia dortmanna	3.3	2a.2	1.2	.	.	+.1	1.2	2a.2	1.2	+.2	1.2	1.3	+.1	+.1-2	1.2
D	Isoetes setacea	.	.	.	$\boxed{1.1}$	$\boxed{1.2}$	.	.	.	.	.	.	.	.	.	.
	Character taxa of Eleocharetum multicaulis															
D	Eleocharis multicaulis	.	.	.	.	.	.	+.2	.	$\boxed{+.1}$	$\boxed{1.2}$	$\boxed{1.2}$	$\boxed{2b.2}$	$\boxed{2b.3}$	$\boxed{1.2-3}$	$\boxed{2a.3}$
	Echinodorus repens	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	2m.2
	Deschampsia setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1
	Character taxa of class and order															
Cl	Juncus bulbosus	+.1	.	1.2	.	2m.3	2b.2	2b.3	1.2	.	.	.	.	.	.	1.2
L	Littorella uniflora	2a.2	2a	r	2m.2	2a.3	2m.2	.	4.4	.	2b.2	5.5	3.3	5.5	3.3	2m.3
L	Luronium natans	.	.	.	2m.2	1.2	.	.	.	.	.	.	.	.	.	.
L	Elatine hexandra	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.
	Character taxa of Phragmitetea															
	Eleocharis palustris ssp. pal.	2m.1	.	.	.	+.2	.	+.2	1.2	.	.	.	.	.	.	.
	Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	.	r.1	.
	Character taxa of Potametea															
	Polygonum amphibium fo. natans	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.
	Potamogeton natans	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.
	Nymphaea alba	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.
	Differentials of Agropyro-Rumicion crispi															
	Hydrocotyle vulgaris	.	.	.	.	.	+.1	.	.	.	.	.	2a.2	.	.	2b.3
	Agrostis canina	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	1.2
	Other phanerogamic companions															
	Molinia caerulea	.	.	.	.	.	.	1.1	.	.	.	.	+.2	2a.3	.	2a.2
	Drosera intermedia	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
	Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	2m.2	.	.	.
	Potentilla palustris	.	.	.	.	.	.	1.1k	.	.	.	.	.	.	.	.
	Carex lasiocarpa	.	.	.	.	.	.	.	.	.	.	1.2	2a.2	1.2	.	.
	Lysimachia vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1
	Bryophytes and algae															
	Sphagnum crassicladum	+.1	.	.	.	.	3.3	+.1	3.3	.	.	.	.	.	.	1.3
	Sphagnum cuspidatum	.	.	1.2	.	.	.	4.4	.	.	.	.	.	.	.	.
	Drepanocladus fluitans	.	.	.	.	3.3	.	2m.2	.	.	.	.	.	.	.	.
	Cladopodiella fluitans	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.
	filamentous algae	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.

D = differential taxa of subassociations
Cl = character taxon of class Littorelletea
L = character taxa of order Littorelletalia

authors
S = M. Schoof - van Pelt
Wi = A. Wittgen

table 4
Isoeto-Lobelietum
France

	subunit number	Ib		VII	
	relevé number	1	2	3	4
	author	S	S	S	S
	year	69	69	69	69
	quadrat size (m^2)	4	2	6	4
	cover %	15-20	50	10	.
	water depth (cm)	50	50	50	.
	number of taxa	3	4	8	9
	Character taxon of association and alliance				
	Lobelia dortmanna	2a.2	3.2	2a.2	1
	Character taxa of Eleocharetum multicaulis				
D	Eleocharis multicaulis	.	.	$\boxed{+.2}$	$\boxed{2m.3}$
	Potamogeton polygonifolius	.	.		+.1
	Character taxon of order				
L	Littorella uniflora	1.1	1.1	2a.3	1
	Character taxa of Phragmitetea				
	Phragmites australis	.	(+)	1.2	+ 1
	Cladium mariscus	.	1.2	.	.
	Scirpus lacustris ssp. lacustris	.	.	+.2	
	Scirpus americanus	.	.	+.1	.
	Iris pseudacorus	.	.	.	+.1
	Other phanerogamic companions				
	Trapa natans	+.1	+.1	.	.
PL	Myriophyllum alterniflorum	.	.	1.2	1
	Najas marina	.	.	1.1	.
	Hydrocotyle vulgaris	.	.	.	1.1
	Ranunculus flammula	.	.	.	2m.2

D = differential taxon of subassociation
L = character taxon of order Littorelletalia
PL = characteristic of both Potametea and Littorelletea

author
S = M. Schoof - van Pelt

table 5

Isoeto-Lobelietum

Great-Britain

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
subunit number				Ib								II							III			IV			V								VII				
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
region	Sc	Sc	Sc	E	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	E	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc	Sc
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
year	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
quadrat size (m^2)	4	2	4	1	3	4	4	4	3	4	4	6	4	4	4	2	4	4	4	2	4	4	4	3	4	2	4	2	4	4	4	4	4	4	2	4	4
cover %	10	5	5-10	40	50	50	80	30	90	40	70	50	50	15	100	40	20	10	70	10	70	5	50	5	90	50	70	10	50	70	90	100	10	80	10	90	80
water depth (cm)	5	5-15	10	20	5	5-10	10	15	2-15	5-10	30	10-20	5-10	10	50-60	20	10	10-20	10	15	5-10	10-30	15-30	10-20	-2 +2	10	5	5-10	1-10	2	5-15	5	10-20	10	10	10-40	5-15
number of taxa	3	3	3	6	3	7	3	5	5	3	5	4	5	5	3	3	7	7	6	5	3	4	5	4	8	4	6	5	6	7	8	9	7	7	6	10	7
Character taxa of association and alliance																																					
Lobelia dortmanna	1.2	1.1	2a.1	2a.3	1.2	1.1	3.3	2a.2	+.1	2a.2	1.2	3.3	2a.2	1.2	4.4	.	1.2	1.2	2a.2	2m.2	.	1.1	1.2	1.1	+.1	2a.2	2a.2	1.1	3.3	2m.2	2b.3	1.1	2a.2	2b.2	1.2	1.1	2a.2
D Isoetes setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2	1.1	+.1	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Isoetes lacustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.3	1.1	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
D Subularia aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.3	.	.	.	.	.	.	.	.	.	.	.	.
Differential of subassociation																																					
PL D Myriophyllum alterniflorum	.	.	.	.	.	.	.	1.3	+.2	1.2	1.2	1.2	1.2	1.1	1.3	2b.3	.	1.2	.	1.1	.	1.2	1.2	.	2b.3	.	.	.	.	.	.	.	1.2	.	.	.	.
Character taxa of Eleocharetum multicaulis																																					
D Eleocharis multicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	2m.3	2b.3	1.3	1.3	2b.3	1.2	1.3	1.3	2m.2	1.3	2m.3	2m.3
D Scirpus fluitans	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	1.3	2a.3	2b.2	3.3
Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	+.1	.	.	.	.	1.2	.	2a.2	.	.	.	1.2	.
Deschampsia setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1.1	.	.	.
Character taxa of class and orders																																					
Cl Juncus bulbosus	2a.3	1.2	1.2	+.2	1.2	2a.2	2a.2	2b.3	1.2	3.3	2b.2	1.2	1.2	2a.2	.	2b.3	2b.2	1.2	2b.3	+.2	.	1.3	.	2a.2	3.3	3.3	1.3	1.2	1.2	.	.	4.4	1.2	2b.3	2m.2	.	2b.2
L Littorella uniflora	.	1.2	1.1	2a 2	2a.2	3.3	3.3	1.2	5.5	.	4.4	.	1.1	2m.2	2b.2	2m.2	1.2	+.1	.	1.2	1.2	.	3.3	1.2	2a.3	1.2	.	2m.2	.	2b.3	3.3	.	1.2	.	.	2m.3	2m.2
U Utricularia intermedia	.	.	.	.				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																																					
Carex rostrata	.	.	.	1.2	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.1	.	.	.	2m.2	1.2	.	+.1	.	1.1	.
Equisetum fluviatile	2m.1	.	.	+.2	.	+.1	.	1.2	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r.1	.	.	.	.	.	.	.	.	.	.
Scirpus lacustris ssp. lac.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	2m.2	.
Eleocharis palustris ssp. pal.	.	.	.	.		.	.	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Potametea																																					
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	.	2a.2°	.	.	.	.	.	1.1	2b.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	1.2	.
Utricularia neglecta	.	.	.	+ 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	1.1	.	.	.	.	.	.
Potamogeton gramineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.
Other phanerogamic companions																																					
Ranunculus flammula	.	.	.	.	.	1.2	.	.	+.1	.	.	.	.	2m.2	.	.	1.2	.	.	.	.	.	.	.	1.2	.	.	.	.	1.2	1.1	1.2	.	.	.	1.2	.
Menyanthes trifoliata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	1.1	.	.	.
Juncus articulatus	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola palustris		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phalaris arundinacea	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
Agrostis stolonifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.
Carex serotina	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.
Carex nigra	.	.	.	.	.	.	.		.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	.	.	.
Molinia caerulea	.					.		.	.	.		.	.	.		.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	1.2	.	.	.	.	.
Carex lasiocarpa	.			.		2m 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryophytes and algae																																					
Fontinalis antipyretica	.	.		.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	2b.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum inundatum		.	.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	3.3	.	.	.	.	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.
Chara globularis fo. delicatula		.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	+
filamentous algae			.	.	.			.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		x	.	x	.	.	.	.	.	.	.	.
Nitella opaca	.					.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

D = differential taxa of subassociations (and variant)
PL = characteristic of both Potametea and Littorelletea
Cl = character taxon of class Littorelletea
L = character taxon of order Littorelletalia
U = character taxon of order Utricularietalia intermedio-minoris

author
S = M. Schoof - v. Pelt

table 6

Isoëto-Lobelietum

Ireland

subunit number				Ia											Ib									II		III			IV					V									VII							
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
author	S	S	W	S	S	W	S	S	S	S	W	S	S	W	W	S	S	S	S	W	S	S	W	S	S	S	S	S	S	S	S	W	S	W	S	W	S	S	S	S	S	S	S	W	S	S	S	S	S	S
year	68	69	69	69	68	68	69	69	69	69	68	69	69	68	68	69	69	69	69	68	69	69	69	69	69	69	69	68	69	69	69	68	69	68	69	68	68	69	68	69	68	69	69	68	69	69	69	68	68	69
quadrat size (m^2)	100	.	20	4	100	.	4	4	4	4	10	4	4	.	1	4	4	1	1	4	1	1	20	4	4	2	4	10	1	4	4	.	4	2	1	.	.	4	6	4	100	4	4	5	4	1	4	100	100	4
cover %	.	70	10	5	75	.	50	50	30	70	60	100	80	.	100	50	80	80	60	80	90	50	60	30	50	70	30	40	40	40	100	.	60	80	15	20	.	60	80	90	60	20	30	70	60	80	100	60	5-10	80
water depth (cm)	100	35-50	50	50	50	60	20-30	10	30	30-60	40	5-10	10-15	.	-5	10-30	10-20	2	5	-	0	0-10	30	5-10	10-15	40-60	20-40	30	10-20	50	15-20	+	20	.	2-15	.	.	20	5	20	30	30-35	0-2	.	0-3	-	10	30	.	20-30
number of taxa	1	2	4	3	5	5	9	3	3	4	7	4	5	10	12	7	9	7	9	3	10	14	12	5	9	7	4	12	5	9	5	7	8	6	8	7	3	5	11	5	6	8	8	10	11	13	14	8	8	11
Character taxa of association and alliance																																																		
Lobelia dortmanna	1.1	1.2	+.2	+.1	2a.3	1.1	1.2	2a.2	+.1	1.2	1.1	+.1	1.2	1.2	+.2	+.1	1.2	2a.3	1.1	1.1	+.1	1.3	+.2	2a.2	1.2	x	1.1	2b.1	2a.2	2a.2	.	2m.1	2b.2	1.1	.	.	2b.3	2b.3	+.2	+.1	+.1	1.2	1.2	2.2	2a.2	1.1	1.2	3.4	+.2	2b.3
△ Eriocaulon septangulare	.	4.4	1.3	1.2	3.3	2.1	2a.2	.	2b.3	4.4	3.3	5.5	4.4	3.3	5.5	2m.3	2b.3	4.4	2a.3	.	2b.2	2b.3	2.3	.	2a.2	x	.	2b.2	2a.2	1.1	.	5.4	2a.3	5.4	.	1.2	3.3	3.3	4.4	4.4	4.4	2m.2	2a.2	4.4	1.2	2a.3	5.5	3.4	2a.3	2b.3
D Isoetes setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	2b.2	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Isoetes lacustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Subularia aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	+.1	2a.2	1.2	2m.2	2m.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential of subassociation																																																		
PL D Myriophyllum alterniflorum	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.5	2a.1	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Eleocharetum multicaulis																																																		
D Eleocharis multicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	1.3	3.3	1.3	+.2	1.2	1.2	1.2	2m.3	2b.3	1.3	1.3	1.2	2m.3
Scirpus fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b.2	.	1.3	.	.	.	.	+.1	.	.	1.3
Deschampsia setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b.2	.	1.2	1.2	.	+.2	1.2	.
Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	.	.	2a.3	.	1.2	.	.	1.2	+.1	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	+.2	.	.	.	.	.	.	2m.2	1.3	.
Hypericum elodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3
Character taxa of various Littorelletea syntaxa																																																		
Cl Juncus bulbosus	.	.	.	.	.	.	.	3.3	1.3	1.1	3.3	2m.3	2a.3	1.2	2.5	2b.3	3.3	1.2	2.2	2.2	3.3	1.2	+.2	.	2b.2	x	1.2	1.2	1.2	2b.2	5.5	1.2	1.2	1.2	2a.2	2.2	.	1.2	+.1	1.2	.	2a.3	2m.2	+.2	2a.2	1.2	1.2	.	.	1.2
L Littorella uniflora	.	.	.	.	.	.	.	2a.2	.	.	3.4	.	.	1.2	.	.	1.2	.	.	4.5	.	.	3.5	2a.2	1.2	.	.	2a.2	.	1.2	.	2.4	.	.	2m.3	.	.	.	1.2	.	.	.	.	.	2b.3	2b.3	1.2	.	.	1.1
E Apium inundatum	.	.	.	.	.	.	1.1	.	.	.	2.3	.	.	.	.	.	1.2	.	2a.3	.	+.1	.	1.1	.	.	.	.	1.2	.	.	.	+.2	.	+.2	.	+.1	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	1.2	.	1.1	.	.	.	+.1	.	.	.	.	+.1	+.1	.	.	.	.	+.2	.	2.1	.	.	+.1	.	.	.	.	.	.	.	+.1	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Eleocharis acicularis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
U Utricularia intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	1.2
U Utricularia minor	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Parvocaricetea																																																		
Menyanthes trifoliata	.	.	1.2	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	+.1	.	1.2
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	+.3	.
Carex nigra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.
Carex lasiocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schoenus nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	(+.3)	.	1.3
Character taxa of Phragmitetea																																																		
Phragmites australis	.	.	.	.	+.2	.	.	.	.	.	.	.	.	fr	1.2	.	.	.	.	.	.	.	.	.	.	x	.	1.1°	.	.	.	.	1.2	.	.	.	.	.	1.2°	.	.	.	.	1.1	.	.	.	.	.	.
Eleocharis palustris ssp. palustris	.	.	.	2m.2	.	.	1.1	.	.	.	.	.	.	fr	.	.	.	.	2m.2	.	.	.	.	.	1.2	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.
Equisetum fluviatile	.	.	.	.	.	.	1.1	.	.	.	2.3	.	.	ab	.	.	.	.	.	.	.	.	1.1	2m.1	1.2	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladium mariscus	.	.	.	.	2b.3	3.3	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	1.2	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex rostrata	.	.	.	.	.	.	.	.	.	.	.	.	1.2	ab	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus lacustris ssp. lacustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	.	1.1	.	.	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
Character taxa of Potametea																																																		
Potamogeton natans	.	.	.	.	.	2.3	x	.	.	.	4.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.
Nymphaea alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	+.2	.	.
Utricularia neglecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.
Callitriche spec.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton perfoliatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton gramineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character and differential taxa of Agropyro-Rumicion crispi																																																		
Hydrocotyle vulgaris	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	2.2	+.1	.	.	.	.	2a.3	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	+.1	.	2.2	.	1.2	2b.2	.	.	.
Agrostis stolonifera	.	.	.	.	.	.	.	.	.	(1.1)	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	+.1	.	.	.	.	.	.	+.1	2m.2	.	.	.
Juncus articulatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	+.1	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.
Leontodon autumnalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other cormophytic companions																																																		
Ranunculus flammula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	+.1	+.1	.	1.2	.	1.2	+.1	.	.	1.1	.	.	.	.	.	+.1	.	.	.	1.2	+.1	.	.	1.2	.	.	.	.	+.1	1.2	1.2	.	.	+.2	.
Molinia caerulea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.3	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1.2	.	.	+.2	+.2	+.2
Anagallis tenella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.
Drosera intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.2	.	.	.	(1.2)	.
Equisetum palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio aquaticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria minor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex panicea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	(1.1)	.
Mentha aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.
Bryophytes and algae																																																		
Sphagnum auriculatum	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1.2	.	2a.2	.	.	.
Sphagnum crassicladum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.
Sphagnum cuspidatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	+.1	.	.	.
Chiloscyphus polyanthus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fontinalis antipyretica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fossombronia spec.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.
Riccardia pinguis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum spec.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chara spec.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
filamentous algae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

△ = geographic differential
D = differential taxa of subassociations
PL = characteristic of both Potametea and Littorelletea
Cl = character taxon of class Littorelletea
L = character taxa of order Littorelletalia
E = character taxa of alliance Eleocharition acicularis
A = character taxon of other Littorelletea association
U = character taxa of order Utricularietalia intermedio-minoris

authors
S = M. Schoof- v. Pelt
W = V. Westhoff

table 7

Eleocharetum multicaulis

The Netherlands

	subunit number	Ia1				Ia2						IIa1						IIa2				IIb1											IIIa			
	relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	author	D	Si	D	D	Si	Si	D	Si	D	Si	Si	D	Si	D	D	D	D	Si	D	D	Si	Si	D	Si	Si	D	Si	Si	D	Si	Si	D	Si	Si	D
	year	39	43	39	39	43	43	39	42	39	43	43	39	41	39	39	39	39	43	39	39	43	42	39	42	43	39	43	43	39	43	41	39	43	43	39
	quadrat size (m^2)	6	25	4	8	.	.	5	20	.	.	.	10	10	10	4	30	.	.	5	.	.	5	12	20	.	3	10	10	½	5-10	.	4	.	.	.
	cover %	.	80	.	.	.	90-100	.	100	100	.		.	90		.	.	.	.	.	.	.	100	.	90	.	.	40	40	.	100	.	.	.	.	.
	water depth (cm)	+	25-35	+	+	5	-1-+1	+	10-30	+	1	.	.	.	.	-	.	+	-	0	.	10-20	2	.	0-10	-	0	0	0	-	-	.	.	.	10-15	-
	number of taxa	14	12	14	11	13	13	18	11	9	13	13	23	20	18	17	17	11	14	13	14	11	11	15	14	12	10	13	13	14	13	16	12	14	13	19
	Character taxa of association																																			
	Eleocharis multicaulis	1.2	1.2	1.2	.	1.2	2.3	1 2	+.2	3.3	.	3 3	2.3	4 5	2.2	3.3	2.4	3.3	3.3	3.3	2.3	2.2	4.4	3.3	4.5	2.2	1.2	1.2	+.2	1.2	3.4	4.5	+.2	3.3	2.2	.
	Hypericum elodes	4.5	+.2	4.5	4.5	2.2	2.2	4 5	2.3	4.5	2.2	3.3	2.3	2.3	3.3	2.3	3.3	2.3	1.2	.	.	+	+.2	2.4	2.2	2.3	2.2	2.2	1.2	3.3	2.2	1.2	4.4	2.3	3.4	1.3
	Ranunculus ololeucos	.	.	.	.	.	.	1.1	.	.	.	(+)	1.2	.	.	.	.	.	.	.	.	(+)	.	.	.	.	.	.	1.1	.	.	.	1.2	+.2	2.2	.
D	Potamogeton polygonifolius	+.3	+.2	1 2	2 2	1 3	1.2	+.2	1.1	+.2	1.2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.
D	Scirpus fluitans	3.4	2.3	3.4	+.3	+.2	+.2	1.2	4.5	2.3	2.2	1.3	2.2	+.2	1.2	2.2	1.2	1.2	2.3	+.2	1.2	.	.	.	.	.	.	.	.	.	(+.2)	.	3.3	3.5	+.2	4.4
D	Deschampsia setacea	.	.	.	.	.	.	.		1.2	.	2.2	2.2	+.2	1.2	2.2	1.2	.	(+)	.	.	+.2	+.2	+.2	1.2	+.2	2.2	+.2	+.2	2.2	3.3	1.2	(+.2)	(+.2)	+.2	.
	Character taxa of other Littorelletea syntaxa																																			
L D	Littorella uniflora		.	.		.	.	.		.	.	3.3	3 4	+.2	4.4	4.4	3.4	4.5	+.1	4.4	4.4	2.3	2.3	3.5	2.3	2.2	4.4	+.1	2.3	1.2	+.2	1.2	.	.		.
E D	Apium inundatum	1.2	(+.1)	+.2	+.1	.	.	.	.	.	.	1.2	1.2	+	1.1	1.2	1.2	.	+.1	.	2.2	.	.	.	+.2	.	.	.	.	.	.	+.2	1.1	2.2	.	+.1
Cl	Juncus bulbosus	3.3	3.4	2.3	+.2	3.4	+.2	2.2	1.2	2.4	3.3	1.2	2.3	1.2	3 3	1.2	3.3	3.3	2.3	3.2	3.4	+.2	1.2	2.3	1.2	3.3	1.2	2.3	3.3	1.2	1.2	1.2	3.4	1.2	3.3	3.3
E	Echinodorus ranunculoides	+ 3	r	.	.	.	2 2	.		+.1	.	+.2	1 1	+.2	.	.	+.2	+.2	.	1.1	2.2	+°	.	.	.	2.2	.	1.2	.	.	+.2	+.2	.	.	.	1.1
L	Luronium natans	.	1 1	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	1.3	.	+.2	.	.	.	.	.	.	.	.	.	1.3	.
Ll	Lobelia dortmanna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	1.2	.	1.2	.	.	.	.	.	.	r	.	.	.	.
A	Pilularia globulifera	.	.	.	.	.	.	.	.	.	.	.	+.2	+.2	.	.	.	.	2 3	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.
A	Sparganium minimum	.	.	.	.	r	+.2		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1
A	Sparganium angustifolium	.	.	.	.	.	.		.	.	.	.	.	+°	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.
	Character taxa of Phragmitetea																																			
	Glyceria fluitans	2.2	.	+.2	2.2	+.2	.	1.2	.	.	.	(+)	2.2	+	.	+.2	.	.	+.2	.	.	1.2	.	.	.	.	.	.	+.2	.	+.2	.	+.2	1.2	+.2	1.2
	Eleocharis palustris ssp. palustris	2 2	1.1	.	3.3	.	.	1.2				.	+.2	+.1	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	+.2	(+)	+.2
	Alisma plantago-aquatica	.		.	.	+	.				.	.	.	+°	.	.	.	.	+.2	+.1	.	.	.	.	r	.	.	.	.	.	r	+	.	+	.	+.1
	Equisetum fluviatile	.	.	.	.		.	+.2	.	.	+ 1	.	+.2	.		.	+.1	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	+.2
	Lysimachia thyrsiflora	.	.	.	.		.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	(+)	.	.	.	.	.	.	.	.	.	.	+.1
	Differential taxa of Agropyro-Rumicion crispi																																			
	Hydrocotyle vulgaris	+ 2	+.1	.	1 2	.	+ 1	+ 2	1.1	.	.	3.3	1.2	2.3	1.2	+.2	.	+.2	1.1	.	.	1.2	1.2	+.2	1.2	1.1	+.2	1.2	+.2	1.3	2.2	+.2	+.2	1.2	1.1	1.2
	Agrostis canina	.	.	.	.	.	.	1.2	1.2	.	+.2	(+)	+.2	(+)	1.2	.	.	.	+.2	1.2	+.2	.	.	.	.	+.2	.	+.2	1.2	1.2	+	.	+.2	+.2	1.2	.
	Veronica scutellata	.	.	.	.	1.2	.	.		.	.	.	1.2	.	1.1	.	1.1	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1
	Character taxa of Parvocaricetea																																			
	Ranunculus flammula	2.2		+ 2	.	+ 2		+.2		.	+.2	1.2	1.2	+	2.2	+.2	1.2	.	1.2	2.2	2.3	.	.	1.2	.	+.2	.	.	.	1.2	1.2	+	.	1.1	+	2.2
	Eriophorum angustifolium	.	.	1.2		.		+.2	.	.	.	.	.		.	1.2	1.1	+.2	.	.	+.1	1.2	.	1.1	.	.	.	2.1	1.1	+.2	.	1.1	.	.	.	.
	Potentilla palustris	.	.	+ 2	+.2	.	.	+ 3	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+°	.	.	.	.
	Carex lasiocarpa	.	.			.	2.3		.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	+	.	.	.	.	.	.	.	.	.	.	.
	Other phanerogamic companions																																			
D	Carex serotina	.	.	.	.		.	.		.	+.1	.	+ 2	.	1 2	+.2	1.2	.	.	+.2	.	.	+.2	2.2	.	1.2	1.2	+.1	.	+.2	.	+	.	.	.	.
	Galium palustre	.	.		.	2.3	.	.	.	.	.	.	1.2	.	1.2	+.2	1.2	.	+.1	1.2	1.2	.	.	1.2	.	.	.	.	.	.	.	.	.	+.1	.	1.2
	Mentha aquatica		.	+.1	.	.	+.1	.	.	.	.	.	1 1	.	1.1	.	1.1	.	+.2	.	.	.	.	+.1	+	.	.	.	.	.	.	.	.	.	.	.
	Molinia caerulea	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	+.2	+k	.	+	.	.	.	.	.
	Drosera intermedia	.	.	.	.		.	.	.	.	1.1	.	.	.	.	+.2	.	.	.	.	.	.	.	+.2	.	.	1.2	.	.	.	.	.	.	.	.	.
	Polygonum amphibium fo. natans	+.2	.	.	.	.		+.2	.	.	.	.	+.2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Ranunculus aquatilis		.	.	.	.	.	.	1 2	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.		.	+.1
	Lythrum salicaria	+.1			.	.	.			.		+	.	.	.	.	.	.	.	.	.	.	.	+.1°	.	.	.	.	.	.	.	.	.	.	.	.
	Samolus valerandi	.	.	.	.	.	.		.	.	.	.	.	.	1.1	.	1.1	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bryophytes																																			
	Sphagnum cuspidatum	.	.	1.3	+.2	.	.	.	.	4.4	.	.	.	.		.	.	1.2	.	.	.	.	.	.	.	.	.	.	+.2	+.2	.	.	2.3	.	3.3	
	Scorpidium scorpioides	.	.	.	.	.	+.2	.	.	.	.	2.2	.	.		+.2	3.4	.	.	3.4	.	.	.	.	.	.	.	.	.	.	3.4	.	.	.	.	.
	Drepanocladus fluitans	.	.		.	.	.	3.3	.	.	.	.		.	.	.	.	.	.	.	3.3	.	.	.	.	.	.	+.2	+.2	1.2	.	.	.	.	1.2	.

Recorded once or twice
Agrostis stolonifera 1.2 (23)
Bidens tripartitus + (8)
Callitriche spec. 1.2 (5), +.2 (32)
Carex curta +.2 (10)
Carex echinata +.1 (10)
Carex panicea 1.1 (23), +.1 (26)
Carex rostrata +.2 (3), +.2 (7)
Carex vesicaria +.2 (1)
Equisetum palustre +.1 (32)
Hammarbya paludosa +.2 (26)
Hottonia palustris +.1 (35)
Hypericum canadense 1.2 (29)
Juncus articulatus +.2 (10), +.2 (25)
Juncus effusus + (27)
Mentha arvensis ssp. austriaca + (13), 1.2 (31)
Menyanthes trifoliata 1.2 (6)
Myriophyllum alterniflorum 1.1 (2)
Oenanthe aquatica +.1 (13)
Oenanthe fistulosa +.1 (35)
Peplis portula 1.2 (5)
Phragmites australis +.1° (6)
Polygonum amphibium fo. terrestre +.2 (4)
Potamogeton natans 2.2 (21), + (24)
Potentilla anserina +.2 (14)
Utricularia minor 1.2 (10)

Bryophytes and algae
Bryum caespiticium +.2 (15)
Calliergonella cuspidata 1.2 (29), +.1 (35)
Chara spec. +.2 (2)
Drepanocladus aduncus 1.3 (12)
Drepanocladus lycopodioides 2.3 (14), 3.4 (20)
Polytrichum formosum + (8)
Riccia fluitans 1.2 (3), +.2 (12)
Sphagnum auriculatum 2.2 (7), 2.3 (15)
Sphagnum crassicladum 2.2 (9), 2.3 (17)

D = differential taxa of subassociations, variants and subvariants
L = character taxa of order Littorelletalia
E = character taxa of alliance Eleocharition acicularis
Cl = character taxon of class Littorelletea
Ll = character taxon of alliance Lobelio-Isoetion
A = character taxa of other Littorelletea associations

authors
D = W.H. Diemont
Si = G. Sissingh

table 8

Eleocharetum multicaulis

The Netherlands

subunit number	Ib2	IIb1	IIb2	IIa	IIIb	IVa	IVb
releve number	1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20	21	22 23 24 25 26 27 28 29 30	31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86	87 88 89 90	91 92 93 94 95 96 97 98 99 100 101
author (SOL)	vD BV BV vD BV BV BV BV vD vD	G V G G vD M V V V V	V	G vD V V G vD G vD vD	V V vD M V G V M V V V V V vD vD vD vD V V V V V V P V vD vD V G G V V V V V V G M BV V V V M M BV M M M P V M M P P P V	G vD V V	V M V V V BV M BV G V V
year	57 59 59 57 59 59 59 59 57 57	58 58 58 58 57 58 58 58 58 57	58	58 57 58 58 58 57 58 57 57	58 57 57 58 58 58 59 58 58 58 58 58 58 57 57 57 57 57 57 57 57 57 57 58 57 57 57 57 58 58 58 58 58 58 58 58 58 58 58 59 59 58 58 58 58 58 58 58 58 58 58 58 58 58 58 57	58 57 57 57	57 58 58 57 57 59 58 59 57 57 57
quadrat size (m^2)	4 3 1½ 8 3 3 1 8 10 15	6 4 9 25 10 4 10 2 10 1	1½	9 10 1 9 10 20 20 25 50	20 2 20 8 10 4 4 20 4 4 4 3 16 9 4 10 10 2 4 1 4 4 10 15 1 4 2 4 16 20 2 1½ 1½ 1 4 1 50 6 3 2 2 4 3 1 1 2 5 4 3 1½ 20 15 8 2 4	12 10 2 1	1 10 4 2 2 1 4 1½ 4 1½ 1½
cover %	70 100 70 80 80 80 95 75 40 40	70 100 80 80 90 80 100 100 100 25	100	90 90 100 100 100 70 90 100 80	90 100 80 95 100 90 90 100 100 65 100 100 100 90 100 100 100 90 100 100 100 100 95 100 100 90 80 35 100 100 100 100 100 100 100 100 100 90 100 90 100 90 100 90 100 95 95 90 90 100 60 90 35 95 90 100 25	100 100 80 95	60 85 90 100 100 100 100 95 80 100 80
water depth (cm)	0 5 15 2 0 40 45 55 60 10 15 50 60 15 25 0	0 2 15 20 10 20 25 2 15 30 35 25 5	15	25 30 10 25 15 16 20 30 60 20 30 30 45	10 15 25 30 45 35 4 20 40 50 30 25 20 22 30 25 40 20 5 10 0 0 20 10 0 10 10 20 10 25 5 10 10 20 35 45 25 0 0 5 10 15 15 20 15 20 20 30 30 5 40 10 50 20 25 20 25 35 20 50 20 15 25 15 + 35 15	30 40 25 40 20 40	30 30 30 0 30 5 15 30 40 30 35 5- 10
number of taxa	7 9 8 9 6 5 6 8 6 6	14 11 17 19 9 7 8 5 8 5	7	12 9 9 8 13 7 16 4 14	8 8 5 4 5 8 11 6 6 5 4 4 6 5 5 6 5 6 3 3 3 3 4 6 4 7 5 6 7 6 5 5 3 3 4 3 6 3 5 5 6 5 6 3 5 4 5 7 5 6 5 8 3 4 4 4	10 4 5 6	4 7 6 5 4 5 9 7 4 6 6
Character taxa of association							
Eleocharis multicaulis	32 +2 32 33 +1 +2 12 32	22 22 43 33 32 12 34 22 32	22	12 2 +2 44 22 33 +2	44 22 33 22 +2 +2 23 +2 12 32 45 r2 23 12 12 12 +2 35 32 35 32 22 22 23 22 22 32 35 22 22 32 34 32 32 32 32 22 22 22 32 34 13 23 34 32 22 33 12 33 22 12 24 23 23 22 32	+2 +2	+2 12 r2 +2
Hypericum elodes	32 55 +1 +2 12 +1 55 +1	12 12 +2 23 (+2) 12	+2	12 32 +2 12 +2 43 12 23	33 22 23 12 +1	r2 +2 +2 (+2)	35 55 44 45 44 43 55 55 33 35 45
Ranunculus ololeucos				+3 r2	r2 22		+2
Echinodorus repens	r1 +1						
D Potamogeton polygonifolius	12 22 44 12 33 44 33 33 22 +2			r2	(+1)		
D Scirpus fluitans				32 32 32 +2 2 +2 23 +3 45		55 55 55 55	22 (12)
D Deschampsia setacea	12	22 12 12 12 12 +2 12 +2 12 12			r1 +2		+2
Character taxa of other Littorelletea syntaxa							
L Littorella uniflora		r1 23 55 45	55	+2 12 +2 +2	+2		41
Cl Juncus bulbosus	12 +1 12 22 12 22 +2 12	23 +2 22 33 22 22 23 23	+2	22 12 12 22 23 22 12 44	33 22 32 44 12 43 55 12 32 32 12 22 22 32 12 +2 12 12 12 12 +2 +2 22 +2 32 12 12 34 +2 32 32 22 12 22 23 +1 23 12 12		12 +2 22 12 22
E Apium inundatum		12 +2		45 22 23		+2	+1
E Echinodorus ranunculoides		+1 12		r1 +1 12	12		
L Luronium natans				+2 23	+2	+2 r2	
U Utricularia intermedia	22 +1 12 +1	22 +2			45 25		
U Utricularia minor	12	(+2) 12 22 32			+2 +1		
A Sparganium minimum	12				+2 +2		+2
Character taxa of Parvocaricetea							
D Carex lasiocarpa	12 12 22 +1 12 22 12 32 22				22 22 +2 44 12 +1		22
Ranunculus flammula		+1 +1 +1 +1		r1 r1	22		
Eriophorum angustifolium	+2 12 12	12 12 +1 22		+1	r2 +2 12 11 +2 +1 22 +2 +2 +1 11 r2 +2 11 +1 (+2) +1 +1 +1 +1 12 12 +1 12 22		r1 12
Carex nigra							
Potentilla palustris				22	(r2) r1 +2	r1	
Character taxa of Phragmitetea							
Carex rostrata	12 12 r1 +2			+1 +2	r1 22		22 +2
Glyceria fluitans				2 22 +2	+2 (r2) (+3)	11 +2 +1	+1 +2 +2
Eleocharis palustris ssp palustris				12 +2	r2	11	12 12 12 22 12
Alisma plantago aquatica		+1 +1		+2 +2 (r2) 12	+1 r2		
Differentials of Agropyro-Rumicion crispi							
Hydrocotyle vulgaris	+2 r1	11 12 12 13 r1 11 12		+2 21 23 +2 +2	12 12 (r1) +2 11 +1 22 22 +1 12 32 +2 +3 11 +2 +2	r1 +2	11 +2 11 12 22 22
Agrostis canina		+2 +2		+2 22	+2 22 22 22 22 22 r2 12 +2 +2 12 22 +2		
Other phanerogamic companions							
Molinia caerulea		12 r2 23 13 32 +2 +2			+2 13 12 12 12 22 12 22 22 12 22 +2 12 r2 +2 13 22 34		
Lysimachia vulgaris		+2 +2 r1		12 r2 + r1 +2	r1 +2	r1	+1
Myrica gale	32 +2 +2	+1 22					21
Potamogeton natans				+2 +2	12 +2	12 +2 +2 +2	22 12 r1 32
Lythrum salicaria							
Mentha aquatica							
Polygonum amphibium fo natans							
Bryophytes							
D Sphagnum cuspidatum		+1 +2 +2	+2	12) 55	22 45 55 55 45 55 22 55 22 +1 55 55 45 55 35 55 55 45 45 44 42 45 45 55 45 5 55 55 55 55 55 34 +1 +1 43 55 44 55 54 55 45 33 55 45 55 +1 +1	r2	45 45
Sphagnum crassicladum		55 55 45	+2	43 +1	44 55 +2 55 35 55 11 3 55 +1 +2 32 33 +2 34 11 11 12 12 +2 +1 +2 55		21
Drepanocladus fluitans			12	12	12 +1 35		+2 55 55
Sphagnum subsecundum	55	+2			22		55
Scorpidium scorpioides		13 23			12		
Sphagnum rufescens							

D differential taxa of subassociations, variants, subvariants
L character taxa of order Littorelletalia
Cl character taxon of class Littorelletea
E character taxa of alliance Eleocharition acicularis
U character taxa of order Utricularietalia intermedio minoris
A character taxon of other Littorelletea association

Recorded once or twice

Agrostis stolonifera 2 2 (28), + 2 **(87)**
Alopecurus aequalis + 2 (28)
Cardamine pratensis 1 2 (36)
Carex hudsonii + 2 (14)
Carex panicea r 1 (36)
Carex serotina r 1 (11) + 2 (36)
Cladium mariscus r 1 (14)
Drosera intermedia 1 2 (11) + 2 (15)
Equisetum fluviatile 1 1 (36) 2 2 (39)
Equisetum palustre 1 1 (26)
Frangula alnus 2 1 (2)
Galium palustre 1 2 (36)
Iris pseudacorus + 2 (12) r (14)
Juncus acutiflorus r 1 (2)
Juncus effusus 2 2 (46), + 1 (97)
Lemna minor + 1 (58)
Lycopus europaeus + 2 (23) + 1 (30)
Nymphaea alba 2 2 (8) 1 2 (33)
Oenanthe aquatica + 1 (28)
Phragmites australis (+ 1) (37), + 1 (92)
Potamogeton gramineus 2 2 (14)
Rhynchospora alba 1 2 (15)
Rhynchospora fusca 1 2 (15)
Salix cinerea + 1 (13)
Typha latifolia + 2 (9)
Veronica scutellata 1 1 (36)

Bryophytes and algae

Amblystegium cf kochii + 1 (28)
Bryum pseudotriquetrum 1 2 (13)
Calliergonella gigantea + 1 (36)
Campylium polygamum 1 2 (28)
C adopodiella fluitans + 2 (69)
Drepanocladus aduncus 1 3 (81)
Drepanocladus exannulatus 2 2 (73)
Drepanocladus lycopodioides + 2 (36)
Gymnocolea inflata 5 5 (45), 5 5 (73)
Sphagnum contortum + 2 (13)
Sphagnum palustre + 1 (48)
Chara globularis var capillacea 5 5 (37)
Sphagnum auriculatum 2 2 (100)

Authors

vD J v Donselaar
BV C A Bastiaanssen + H J Verhoeven
G P Glas
V E E v d Voo
M H Moller Pillot
P J H Peters

table 9
Eleocharetum multicaulis
The Netherlands

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
subunit number	Ia2	IIb1								IIb2										
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
year	71	68	68	68	69	69	70	70	69	69	70	69	68	68	70	68	68	69	69	70
quadrat size (m^2)	1	1½	4	4	1	4	6	3	4	4	1	4	2	4	1	2	1½	4	4	4
cover %	100	50	60	.	60	90	80	100	100	90	.	100	70	25	50	.	90	100	90	100
water depth (cm)	-	5- -5	20-30	15	-	-	-	2	15	0-5	0	15	5-25	5	-	5- -1	20	10	15	0
number of taxa	10	19	22	15	11	11	18	9	9	10	10	6	8	6	14	8	9	7	6	8
Character taxa of association																				
Eleocharis multicaulis	+.2	2b.3	1.3	2m.3	2m.3	3.3	3.5	3.3	2a.3	3.3	1.2	1.3	3.3	.	+.1	+.2	2m.2	2m.3	2b.3	2b.2
Hypericum elodes	3.4	3.3	+.2	2a.2	.	1.3	.	.	.	.	.	.	1.2	+.2	.	.	1.2	2m.2	.	.
Ranunculus ololeucos	1.1	+.1	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.
Echinodorus repens	.	.	.	.	1.2	.	.	.	.	.	.	.	+.1	.	1.1	.	.	.	.	.
D Potamogeton polygonifolius	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Scirpus fluitans	1.2	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Deschampsia setacea	.	+.2	2m.3	+.1	2m.2	+.1	1.2	1.1	+.1	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																				
L D Littorella uniflora	.	1.2	.	1.1	1.2	.	1.2	.	1.1	2m.3	.	2m.2	4.5	.	2m.2	1.2	4.4	2m.3	.	2a.2
Cl Juncus bulbosus	2a.2	1.2	1.1	5.5	+.1	2a.2	1.2	2b.2	5.5	2m.3	3.3	5.5	.	2b.3	1.2	1.2	.	5.5	3.3	1.1
E Apium inundatum	.	+.2	+.1	2b.2	.	.	.	.	.	.	1.1	.	.	+.1	.	.	.	.	.	.
E Echinodorus ranunculoides	.	+.1	2m.2	+.1	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
L Luronium natans	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.
A Pilularia globulifera	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																				
Eleocharis palustris ssp. palustris	.	.	+.1	.	.	.	.	.	.	+.2	.	.	1.2	.	1.2	.	.	.	.	+.1
Lycopus europaeus	.	r.1	+.1	+.2	.	.	r.1	.	.	.	.	.	.	.	+.1	r.1	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.
Alisma plantago-aquatica	.	+.1	.	+.1	.	.	.	.	.	.	r.1	.	.	.	.	.	+.1	.	.	.
Differentials of Agropyro-Rumicion crispi																				
Hydrocotyle vulgaris	.	1.2	2a.1	+.1	2a.2	1.2	3.3	2b.2	+.1	2a.2	+.1	.	2a.2	.	3.2	.	.	1.2	.	+.1
Agrostis canina	2m.2	.	1.2	+.1	1.2	1.2	2m.2	.	2m.2	.	.	2m.2	.	+.1	.	1.2	2m.2	.	2m.2	.
Character taxa of Parvocaricetea																				
Eriophorum angustifolium	.	.	+ 1	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus flammula	+.1	1.2	1.2	1.1	.	+.1	1.1	.	.	.	+.1	.	.	+.1	.	.	.	.	.	.
Potentilla palustris	.	.	+.1	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex lasiocarpa	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other phanerogamic companions																				
Molinia caerulea	1.2	.	.	.	2b.2	2m.2	2a.1	+.1	.	+.2	.	.	.	.	.	.	1.2	.	.	.
Carex serotina	.	.	+.1	.	1.3	.	2a.2	.	.	.	.	.	.	.	2a.2	.	.	.	.	.
Lythrum salicaria	.	+.1	.	1.2	.	.	+.1	.	.	.	.	.	.	+.1	.	.	.	.	.	.
Lysimachia vulgaris	.	.	+.1	.	.	.	.	.	+.1	.	.	.	r.1	.	.	.	.	.	.	.
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.
Myrica gale	.	.	.	.	.	+.1	r^k	.	+.2	.	.	.	.	.	.	.	.	.	.	.
Drosera intermedia	+.2	.	.	.	1.2	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Bidens tripartitus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium palustre	.	+.2	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.
Bryophytes																				
D Sphagnum cuspidatum	.	.	.	.	.	.	.	4.4	.	.	.	.	.	.	.	.	.	.	4.4	+.1
Sphagnum crassicladum	.	.	.	.	+.2	.	.	1.1	4.4	.	.	2.2	.	.	.	.	1.3	2	+.1	5.5
Drepanocladus fluitans	.	.	.	.	.	.	.	.	.	3.3	.	+.1	.	.	.	.	+	.	.	1.1

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
subunit number				IIIa						IIIb										
relevé number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
year	71	68	68	68	68	68	69	68	68	68	70	70	68	69	68	68	68	68	68	68
quadrat size (m^2)	1	4	3	6	1	2	4	16	4	9	2	1	4	4	4	3	4	9	9	10
cover %	80	95	50	75	10	60	100	.	95	90	90	90	60	60	60	50	75	100	75	100
water depth (cm)	-	30-40	0	10-30	5-10	0	0-20	40-50	5-50	45-50	10	0-10	25-30	10-15	10-30	5- -2	0-25	20	30-35	25
number of taxa	15	10	10	12	7	8	9	5	8	4	8	7	4	4	9	6	5	5	5	5
Character taxa of association																				
Eleocharis multicaulis	+.1	.	.	1.2	.	.	.	.	.	2m.2	4.4	3.3	2m.2	4.4	1.3	3.3	3.4	2a.2	3.3	1.2
Hypericum elodes	3.3	1.2	1.2	3.3	r.2	.	3.3	.	+.1	.	.	.	.	.	.	.	.	.	.	.
Ranunculus ololeucos	+.1	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.
Echinodorus repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Scirpus fluitans	2.2	2b.3	+.1	2m.3	1.1	1.2	2b.2	2m.4	2a.2	.	.	.	.	.	.	.	.	.	.	.
D Deschampsia setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																				
L D Littorella uniflora	.	.	+.1	r	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cl Juncus bulbosus	1.2	.	+.2	.	+.1	3.3	2a.2	4.4	3.3	1.1	2b.2	2b.2	3.3	.	2a.2	1.2	2b.2	2a.2	2b.2	2b.2
E Apium inundatum	2.2	1.2	+.1	2m.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Luronium natans	.	+.1	.	+.2	.	.	.	.	r.1	.	.	.	.	.	.	.	.	.	.	.
A Pilularia globulifera	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																				
Eleocharis palustris ssp. palustris	.	1.2	.	+.1	1.1	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	+.2	.
Lycopus europaeus	.	.	.	.	.	r.1°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans	.	1.1	.	+.1	.	.	+.1	.	.	.	.	.	.	.	1.2	.	.	.	.	.
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differentials of Agropyro-Rumicion crispi																				
Hydrocotyle vulgaris	+.1	+.1	3.3	1.1	.	.	.	.	+.1	.	2a.2	.	.	.	1.2	.	.	.	.	.
Agrostis canina	1.1	.	+.2	.	+.1	2a.2	1.2	1.2	+.1	.	1.1	1.1	.	.	.	.	.	.	.	.
Character taxa of Parvocaricetea																				
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	+.1	.	1.2	+.2	2a.2	.	+.1	.	2b.3
Ranunculus flammula	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla palustris	+.1	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex lasiocarpa	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.
Other phanerogamic companions																				
Molinia caerulea	.	.	+.1	+.2	+.1	+.1	.	.	.	.	1.2	.	.	.	.	2a.2	.	.	.	.
Carex serotina	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton natans	.	4.3	.	2b.2	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.
Myrica gale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drosera intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bidens tripartitus	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryophytes																				
D Sphagnum cuspidatum	.	.	.	.	.	.	.	.	.	.	+.1	.	+.1	+.1	2.2	+	3.3	5.5	4.4	5.5
Sphagnum crassicladum	.	+.1	+.1	.	.	.	.	2.2	3.3	5.5	5.5	4.3	4.4	2.2	2.2	+	1.2	1.1	+	+.1
Drepanocladus fluitans	+	3.4	.	2a.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
subunit number													IVa				IVb			
relevé number	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
year	68	69	68	68	68	68	68	68	68	70	71	68	68	70	68	70	70	68	68	68
quadrat size (m^2)	10	4	4	.	3	2	3	4	2	20	2	2	1½	2	9	1	2	2	1½	1
cover %	100	.	5-10	95	25	40	30	75	95	100	100	50	50	90	100	50	100	80	100	90
water depth (cm)	2- -2	10	10	30	-	20	0-25	0-5	.	-	-	30	0	-	15	20-40	-	+	30	+
number of taxa	5	4	3	3	9	5	5	7	9	6	4	2	10	7	9	5	10	7	6	10
Character taxa of association																				
Eleocharis multicaulis	3.3	3.3	2m.2	+.1	+.1	1.2	1.2	3.3	1 2	4.3	4 3	2m.3	.	.	+.1	+.2	.	.	.	1.2
Hypericum elodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	5.5	5.5	5.5	4.4
Ranunculus ololeucos	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.
Echinodorus repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
D Scirpus fluitans	.	.	.	.	.	.	.	.	.	.	.	.	3 3	5.5	5.5	2b.2	.	.	.	.
D Deschampsia setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																				
L D Littorella uniflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.4
Cl Juncus bulbosus	+.1	3.3	.	2b.3	2a.2	2b.2	2b.3	+.1	4.5	2b.2	2a.2	.	.	2a.2	.	.	2b.2	1.2	.	+.1
E Apium inundatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.
L Luronium natans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Pilularia globulifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																				
Eleocharis palustris ssp. palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.2°	.	.	.
Lycopus europaeus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	2b.3	+.1	.	.	.	r.1	r.1	.
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Differentials of Agropyro-Rumicion crispi																				
Hydrocotyle vulgaris	.	.	.	.	.	.	.	.	2a.2	2a.1	.	.	1.2	.	.	.	2b.2	+.2	+.2	+.1
Agrostis canina	.	.	.	.	r.1	.	.	.	2a.2	.	1.2	.	.	.	.	.	1.2	+.1	.	1.3
Character taxa of Parvocaricetea																				
Eriophorum angustifolium	.	+.1	.	.	.	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	2m.2
Ranunculus flammula	.	.	.	.	.	.	.	.	+.1	.	.	.	+.1	.	.	.	.	.	.	.
Potentilla palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.
Carex lasiocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.
Other phanerogamic companions																				
Molinia caerulea	1.1	.	+.2	.	2m.2	1.2	.	2a.2	+.2	+.1	.	.	.	.	.	.	.	.	.	+.1
Carex serotina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.
Lysimachia vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r.1	.	.	.	r.1	.
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	.	2b.3	.	1.2	2m.2	2b.2	.	.	.	+.1
Myrica gale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	r.1	.
Drosera intermedia	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Bidens tripartitus	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	1.1	.	.	.
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.
Mentha aquatica	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.
Bryophytes																				
D Sphagnum cuspidatum	5.5	3.3	+.1	5.5	+.1	3.3	1.2	4.4	.	4.3	4.4	.	.	.	.	.	.	.	.	.
Sphagnum crassicladum	+	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.
Drepanocladus fluitans	.	.	.	.	.	.	.	.	.	3.3	.	.	.	.	.	.	+	.	.	.

Recorded once or twice
Agrostis stolonifera 1.1 (3), 1.2 (8)
Alopecurus aequalis r.1 (11)
Betula spec. +.1^k (46)
Calluna vulgaris +.1 (45)
Cardamine pratensis +.1 (53)
Carex acuta 2a.2 (15)
C. rostrata 1.1 (31)
Crataegus monogyna +.1^k (15)
Drosera rotundifolia +.1 (7), +.1 (8)
Equisetum fluviatile 1.1 (54)
Erica tetralix r.1 (45)
Frangula alnus r.1^k (23)
Iris pseudacorus +.1 (3)
Juncus acutiflorus +.1 (58)
Juncus effusus 1.2 (16), +.1 (49)
Lemna minor +.1 (16), +.1 (27)
Lysimachia thyrsiflora +.1 (15)
Nymphaea alba r.1 (35), 1.2 (37)
Oenanthe aquatica +.1 (27), +.1 (17)
Polygonum amphibium
fo. natans +.1 (10), +.1 (17)
Potentilla anserina +.2 (3)
Quercus robur r.1^k (7)
Ranunculus aquatilis 1.2 (57)
Ranunculus repens +.1 (3)
Rhynchospora alba 1.2 (48)
Rhynchospora fusca +.1 (7), + 1 (48)
Rorippa islandica 1.2 (53)
Solanum dulcamara r.1 (59)
Taraxacum spec. +.1 (3)
Typha angustifolia 1.2 (54)
Typha latifolia r (56), + (57)
Utricularia minor 1.2 (32), r 1 (47)

Bryophytes
Aulacomnium palustre +.1 (15)
Bryum pseudotriquetrum 1.2 (2)
Calliergon cordifolium +.1 (21)
Calliergonella cuspidata + (21)
Cladopodiella fluitans r (45)
Drepanocladus lycopodioides 3.3 (3)
Leptodictyum Kochii 1.1 (14)
Leptodictyum riparium r (2)
Scorpidium scorpioides +.1 (7)
Sphagnum auriculatum + (48), + (60)
Sphagnum inundatum +.2 (2), 1.2 (26)
Sphagnum majus + (32)

D - differential taxa of subassociations, variants and subvariants
L = character taxa of order Littorelletalia
Cl - character taxa of class Littorelletea
E = character taxa of alliance Eleocharition acicularis
A = character taxon of other Littorelletea association

author
S = M. Schoof- v. Pelt

table 10

Eleocharetum multicaulis

France

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
subunit number	Ia1								Ia2										IIb2								IIIa										IIIb				IVa					IVb
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
year	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
quadrat size (m^2)	4	4	1½	2	10	3	4	4	3	6	2	2	4	4	3	4	10	4	4	6	1	2	1	4	2	1	4	10	1½	3	4	1	4	10	3	3	4	2	3	4	9	4	4	4	2	2
cover %	90	90	90	100	90	70	100	100	90	80	100	90	90	100	90	90	100	90	90	100	80	40	70	80	90	90	80	40	90	60	30	60	100	80	95	90	100	80	30	60	100	90	90	100	95	80
water depth (cm)	40	10-20	20-30	20-35	5	20-40	40	20	0-5	0-5	5	0-10	0-20	30-40	5-10	10	30-40	15	-5	10-20	0	-1-10	5-10	0	0-5	15-50	10	15-20	15	-1-1	10	10-15	10-25	15-20	25	20	5	15-20	40	15	10-25	85	60	25	10-20	30
number of taxa	7	14	14	7	17	11	8	9	15	9	15	21	16	10	10	15	10	13	21	17	16	9	7	13	15	8	15	10	10	16	10	7	10	10	12	6	11	10	6	7	10	4	3	4	7	6
Character taxa of association																																														
Eleocharis multicaulis	.	1.3	1.3	.	4.4	.	.	2m.2	1.3	2b.3	2m.2	2m.3	2m.3	1.2	1.2	4.4	.	+.2	4.4	.	1.2	2m.3	2m.2	1.2	3.3	2a.3	1.2	1.1	.	2b.3	3.1	2m.3	+.1	2m.3	2m.3	2m.2	2a.3	2a.3	2m.2	3.3	.	.	.	.	.	.
Hypericum elodes	.	.	1.2	1.2	+.2	+.1	+.1	1.2	1.2	2a.3	2b.3	1.2	1.2	1.2	2a.3	2a.2	1.3	.	+.1	+.2	.	.	.	2a.2	+.1	.	.	.	2b.3	1.2	2a.3	.	2b.2	.	4.3	+.1	.	1.2	2a.3	1.2	+.3	.	.	.	.	4.4
Echinodorus repens	+.1	2a.2	1.2	.	2m.2	.	.	.	.	.	.	2a.2	.	+.1	.	.	1.2	2m.2	.	.	.	.	.	.	.	.	2m.2	1.1	.	1.2	1.1	2m.2	.	2m.3	.	.	.	2a.3	.	.	.	.	.	.	.	.
Deschampsia setacea	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Potamogeton polygonifolius	4.4	.	+.1	3.3	.	+.1	1.2	+.1	4.3	3.3	2b.2	2b.3	2b.4	2b.3	1.1	2a.2	5.5	4.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.
D Scirpus fluitans	1.1	3.3	.	2a.2	2m.2	2m.2	5.5	4.4	2m.2	.	+.2	2a.5	4.4	5.5	1.2	+.1	2m.2	2a.3	.	+.2	.	.	.	.	.	.	1.3	+.1	2m.2	+.1	1.2	1.2	3.3	2a.2	1.3	2b.3	.	.	.	.	5.5	4.4	5.5	5.5	4.4	.
Character taxa of other Littorelletea syntaxa																																														
E D Apium inundatum	3.3	2a.3	2b.2	.	2a.2	+.1	1.3	1.2	.	.	.	.	.	.	+.1	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.
L D Luronium natans	2a.2	.	+.1	.	.	2a.3	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.
Differential taxon subvariant																																														
PL D Myriophyllum alterniflorum	.	.	.	2m.2	.	2a.2	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	1.1	.	.
L D Littorella uniflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	2b.2	2m.1	3.3	2b.2	5.5	2m.2	5.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2
Cl Juncus bulbosus	.	2m.2	.	.	1.2	2a.3	2m.3	2m.2	2m.2	.	.	2b.2	1.2	.	3.3	2m.3	.	2m.3	.	2m.2	2m.3	1.2	+.1	+.2	2m.2	.	3.3	.	.	1.2	.	2m.3	.	3.3	1.2	.	.	3.3	.	.	2a.3	.	.	1.1	.	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	+.1	.	2b.2	.	.	.	.	.	.	.	.	.	.	.	.	2b.3	1.2	.	1.1	.	.	.	.	.	.	.
△ Juncus heterophyllus	.	.	.	.	.	.	.	.	.	2b.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.4	.	4.4	.	.	2b.2	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.
△ Thorella verticillata-inundata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																																														
Eleocharis palustris ssp. palustris	2m.1	1.2	1.1	.	.	.	.	.	.	.	2m.1	.	.	+.1	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2
Glyceria fluitans	.	.	+.1	2m.2	.	2m.2	.	.	.	.	+.3	.	.	1.2	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	+.1	.	.	.	.	.	.	1.3	.	.	.	+.1	+.2	.	.	.	.	.	.	.	+.1	2a.2	.	2m.2	.	.	.	.
Lycopus europaeus	.	.	.	.	.	.	.	.	+.1	.	.	+.1	+.1	.	.	+.1	+.1	.	+.1	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Iris pseudacorus	.	.	.	.	.	.	.	.	+.1	.	.	1.1	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
Scirpus americanus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	+.1	.	.	.	.	.	.	.	.	+.1	.	1.1	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character and differental taxa of Agropyro-Rumicion crispi																																														
Agrostis stolonifera	.	2m.1	1.2	.	2m.1	.	.	.	+.1	1.2	1.2	1.2	2m.2	1.1	.	1.1	.	1.2	.	2m.2	+.1	+.1	.	2m.2	2m.2	.	1.2	+.1	1.2	.	.	1.1	1.1	+.1	2m.2	1.1	.	.	1.1	.	.	.	+.1	.	.	.
Hydrocotyle vulgaris	.	.	1.2	.	.	.	.	+.1	1.1	1.1	2b.2	3.3	1.1	1.1	1.1	+.1	+.1	2a.2	1.2	2a.1	.	.	.	2a.2	3.3	2a.2	2a.2	+.1	.	.	.	.	2a.2	.	2a.2	.	.	.	.	.	+.1	.	.	+.2	.	.
Veronica scutellata	.	.	.	.	1.2	.	.	.	.	1.2	.	.	.	.	.	.	.	1.2	.	.	.	.	.	+.1	1.1	.	+.1	.	+.1	.	.	.	1.1	.	1.2	.	.	.	.	.	.	.	.	.	.	.
Potentilla anserina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.
Character taxa of Potametea																																														
Ranunculus aquatilis	.	1.2	1.2	+.1	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	+.1	2a.2	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2
Utricularia neglecta	1.1	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum amphibium fo. natans	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1
Callitriche spec.	.	1.2	2m.3	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Parvocaricetea																																														
Ranunculus flammula	.	1.2	.	.	1.2	.	+.1	.	1.1	+.1	2a.2	2m.2	+.1	.	+.1	.	.	.	1.2	1.1	1.2	+.1	.	2m.2	1.1	.	.	.	1.1	1.1	+.1	+.1	1.1	+.1	1.1	.	1.2	1.2	.	.	+.1	.	.	.	.	+.1
Juncus articulatus	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	1.2	.	.	.	.	.	.
Carex demissa	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	1.3	.	.	+.2	.	.	.	.	.	.	.	.	.
Carex echinata	.	.	.	.	.	.	.	.	+.2	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.
Character taxa of Molinietalia																																														
Carum verticillatum	.	+.1	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	2b.2	+1	.	.	+.1	.	+.1	.	2a.2	.	.	.	.	+.1	.	.	2	.	.	.	.	.	.	.	.	.
Anagallis tenella	.	.	.	.	.	.	.	.	2a.3	.	.	+.1	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	+.1	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium dissectum	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	+.1	.	1.1	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other pharerogamic companions																																														
Galium palustre	.	+.1	.	.	1.2	.	.	.	.	.	+.2	+.1	.	.	.	.	.	2m.2	.	.	+.1	.	.	1.2	1.1	.	2a.2	.	.	.	.	.	2m.2	+.1	1.2	.	2a.2	.	.	.	.	+.1	+.1	.	.	.
Mentha aquatica	.	.	.	.	+.1	.	.	.	+.1	.	1.1	+.1	.	.	.	+.1	.	2a.2	+.1	1.2	+.1	.	1.2	1.2	+.1	.	1.1	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
Molinia caerulea	.	.	.	.	.	.	.	.	2m.2	2a.3	.	1.2	.	.	.	1.2	.	+.1	1.2	.	2m.2	.	.	.	.	+.2	+.1	1.1	.	1.2	.	.	.	.	+.3	.	.	2m.2	.	.	.	.	.	.	.	.
Carex serotina	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	1.2	.	.	2m.2	.	2m.2	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drosera intermedia	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	+.1	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myrica gale	.	.	.	.	.	.	.	.	+.1	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
Bryophytes																																														
Sphagnum crassicladum	.	.	.	2b.3	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	1.3	.	4.4	.	.	.	.	.	+.1	.	.	.	.	.
Drepanocladus exannulatus	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	+	.	.	.	+.1	.	.	.	.	.

recorded once or twice

Alisma plantago-aquatica +.1 (13)
Cardamine pratensis +.1 (11)
Carex hudsonii 1.3 (40)
Carex nigra +.1 (15)
Carex trinervis +.1 (30)
Carex vesicaria +.1 (24)
Cicendia filiformis +.1 (19)
Drosera rotundifolia 1.1 (19),+.1 (30)
Equisetum fluviatile 1.1 (45)
Galium constrictum + 1 (11),1.1 (19)
Glyceria declinata 2m.2 (2)
Hydrocharis morsus-ranae +.1 (40),+.1 (45)
Hypochaeris radicata 2a.1 (21),+.1 (22)
Juncus acutiflorus +.2 (29),1.2 (33)
Juncus articulatus var. littoralis 1.2 (19),1.2 (30)
Juncus effusus 1.3 (13)
Lemna minor 2m.2 (3),+.1 (14)
Leontodon autumnalis 1.1 (25),2m.2 (37)
Lobelia dortmanna 1.1 (28)

Lotus uliginosus +.1 (25)
Ludwigia palustris +.1 (13),+.2 (45)
Lysimachia vulgaris +.1 (13),+.1 (26)
Lythrum salicaria +.1 (13),+.1 (27)
Montia fontana ssp. intermedia 1.3 (11)
Nymphaea alba +.1 (12),+.1 (45)
Oenanthe fistulosa +.1 (27)
Pedicularis palustris 2a.2 (24)
Peplis portula 1.1 (6),1.2 (7)
Poa trivialis +.2 (5)
Rhynchospora fusca +.1 (16),2m.2 (30)
Rorippa amphibia +.2 (20)
Salix repens +.1 (21),2a.2 (35)
Scorzonera humilis +.1 (37)
Trifolium repens +.1 (19)
Utricularia minor +.1 (31)

Bryophytes and algae

Calliergonella cuspidata 1.2 (21)
Campylium polygamum +.1 (21)
Chara spec. 1.1 (28)
Drepanocladus aduncus +.1 (5)
Fontinalis antipyretica + (22)
Nitella spec. 2 (18),2m.3 (39)
Sphagnum auriculatum 1.3 (12),1.2 (32)
Sphagnum inundatum 1.3 (38)
Sphagnum palustre 1.3 (12)

D = differential taxa of subassociations, variants and subvariants
E = character taxa of alliance Eleocharition acicularis
L = character taxa of order Littorelletalia
PL = characteristic of both Potametea and Littorelletea
Cl = character taxon of class Littorelletea
△ = geographical differential taxa

author

S = M. Schoof - van Pelt

table 12

Eleocharetum multicaulis

Scotland

		Ib1		IIb1		IIb2		IIIb
	relevé number	1	2	3	4	5	6	7
	author	S	S	S	S	S	S	S
	year	69	69	69	69	69	69	69
	quadrat size (m^2)	4	2	1	4	2	4	4
	cover %	5-10	60	50	80	30	50	90
	water depth (cm)	0-5	1	-	2	0	-	5
	number of taxa	5	15	11	10	3	10	7
	Character taxa of association							
	Eleocharis multicaulis	+.3	+.1	1.2	2b.3	2a.3	2a.3	3.3
D	Potamogeton polygonifolius	2a.2	2a.2	.	.	.	.	.
D	Deschampsia setacea	.	.	2a.2	2a.2	.	.	.
	Character taxa of other Littorelletea syntaxa							
L D	Littorella uniflora	.	.	2a.2	2m.2	2m.3	2b.3	.
Cl	Juncus bulbosus	+.3	1.1	1.2	1.2	1.2	.	.
U	Utricularia intermedia	.	+.1	.	.	.	.	.
	Character taxa of Parvocaricetea							
	Ranunculus flammula	.	.	2m.2	2m.2	.	1.2	+.2
	Carex nigra	.	1.1	1.2	.	.	.	.
	Eriophorum angustifolium	.	+.1	.	.	.	.	+.1
	Carex demissa	.	.	.	2a.2	.	.	.
	Menyanthes trifoliata	.	.	.	.	.	.	2a.2
	Character taxa of Phragmitetea							
	Phragmites australis	+.1	+.1	.	.	.	.	.
	Carex rostrata	1.2	2m.2	.	.	.	.	.
	Eleocharis palustris ssp. palustris	.	.	2m.2	.	.	.	.
	Other cormophytic companions							
	Carex panicea	.	+.1	2a.1	+.1	.	1.2	1.3
	Molinia caerulea	.	1	+.1	.	.	.	.
	Carex serotina	.	.	1.2	.	.	1.3	.
	Myrica gale	.	+.1	.	.	.	.	.
	Narthecium ossifragum	.	+.1	.	.	.	.	.
	Carex limosa	.	2m.2	.	.	.	.	.
	Juncus articulatus	.	.	1.2	.	.	.	.
	Nardus stricta	.	.	.	2a.3	.	.	.
	Utricularia neglecta	.	.	.	.	.	.	4.4
	Equisetum palustre	.	.	.	.	.	.	1.1
	Bryophytes							
	Sphagnum crassicladum	.	1.3	.	.	.	.	.
	Sphagnum apiculatum	.	r	.	.	.	.	.
	Sphagnum auriculatum	.	.	.	1.2	.	.	.
	Drepanocladus revolvens	.	.	.	1	.	.	.
	Bryum spec.	.	.	.	.	.	+.1	.
	Lophozia bicrenata	.	.	.	.	.	.	.
	Cephalozia connivens	.	.	.	.	.	3.3	.
	Haplozia riparia	.	.	.	.	.	.	.
	Pellia epiphylla	.	.	.	.	.	.	.

D = differential taxa of subassociations and subvariant
L = character taxon of order Littorelletalia
Cl = character taxon of class Littorelletea
U = character taxon of order Utricularietalia intermedio-minoris

author
S = M. Schoof - van Pelt

table 13
Eleocharetum multicaulis
Ireland

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	subunit number	Ia 2							Ib 1								II			IIIa				IIIb					
	relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	author	W	S	W	W	S	S	W	W	S	S	W	S	W	S	S	S	W	W	S	S	W	S	S	S	S	S	S	S
	year	68	68	68	69	69	69	69	69	69	68	69	69	69	68	68	69	68	68	69	68	70	69	69	69	69	69	69	69
	quadrat size (m^2)	20	4	4	16	4	1	2	10	2	10	10	4	2	100	63	4	.	4	4	1½	4	3	1	1	1	4	2	4
	cover %	90	95	80	90	50	90	70	80	100	100	80	70	60	5-10	100	80	.	100	80	70	70	100	90	30	100	60	40	30
	water depth (cm)	10-20	20-30	1-5	2-3	20	-	2-3	+	5-10	+	2	40-50	1-5	.	100	20-30	-	-	30	-	5-15	5-10	0	10-20	0	-	2-5	0
	number of taxa	12	14	16	18	5	11	17	17	8	5	19	8	17	8	13	9	11	8	5	11	12	10	10	4	6	14	6	9
	Character taxa of association																												
	Eleocharis multicaulis	.	.	2.2	1.2	1.3	1.3	.	2.3	.	1.2	2.2	1.2	4.2	1.2	2a.3	2a.3	2m.2	+.2	1.2	.	2m.2	2m.2	2m.3	.	.	1.3	1.3	1.2
	Hypericum elodes	.	.	.	4.3	.	2b.3	$1.^{2}$	+.2	5.5	.	.	4.4	+.2	.	2b.3	1.3	.	.	+.2	.	.	5.5	.	2b.3°	2b.3	3.3	2b 3	2a.3
	Deschampsia setacea	.	.	.	.	.	.	.	1.2	.	.	1.2	.	.	1.2	.	.	+.1	.	.	.	.	.	.	.	1.2	.	.	.
D	Potamogeton polygonifolius	3.2	+.1	3.2	2.1	+.1	2b.3	$1.^{2}$	1.2	1.2	2a.2	+.1	1.1	+.2	1.3	2a.3	.	.	.	.	.	.	.	.	.	.	.	.	.
D	Scirpus fluitans	2.3	2a.2	1.2	3.3	3.3	1.2	$1.^{2}$	.	.	.	.	.	.	.	.	1.3	.	.	4.4	3.3	3.3	2a.3	.	.	.	.	.	.
	Character taxa of other Littorelletea syntaxa																												
L D	Littorella uniflora	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1.1	3.4	5.5	.	1.1	.	.	.	.	.	.	.	.
LI △	Eriocaulon septangulare	2.2	+.1	2.2	.	.	1.2	.	.	+.2	.	3.3	.	.	2a.3	.	.	.	.	.	.	.	.	1.3	2m.3	2b.3	1.2	.	1.2
Cl	Juncus bulbosus	1.2	4.4	1.2	2.2	1.2	3.3	$4.^{4}$	3.3	2m.3	.	.	.	1.2	.	+.1	1.2	2m.2	2.2	.	+.1	.	1.2	1.2	.	2m.2	1.2	2m.3	1.2
U	Utricularia intermedia	2.2	1.1	1.2	.	.	.	.	.	.	2m.1	1.1	.	+.2	.	.	1.2	.	.	.	.	.	.	.	.	.	.	1.2	1.1
LI	Lobelia dortmanna	.		.	.	.	+.1	.	.	.	.	.	.	.	+.4	.	2b.3	.	.	.	.	.	.	.	+.1	1.2	.	.	.
A	Sparganium minimum	+.2	+.1	.	.	.	.	$1.^{2}$	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
E	Apium inundatum	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.
E	Echinodorus ranunculoides	.	.	.	+.1	.	.	2^{2}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
U	Utricularia minor	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
	Character taxa of Parvocaricetea																												
	Ranunculus flammula	1.2	+.1	1.1	2.2	.	+.1	$1.^{2}$	3.3	.	.	+.1	.	+.1	+.2	+.2	.	2m.1	2m.1	.	1.1	1.1	.	1.2	.	.	.	1.2	.
	Eriophorum angustifolium	.	.	.	+.2	.	.	.	1.1	.	.	.	.	.	+.3	.	.	.	.	.	.	.	+.1	2m.3	.	.	.	.	.
	Menyanthes trifoliata	.	+.2	.	2.2	.	.	.	.	.	.	+.2	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.1
	Carex nigra	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	+.2	.	.	.	.	.	.	.	2m.3	.	.	.	.	.
	Carex demissa	.	.	+.1	+.2	.	.		.	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Pedicularis palustris	.	.	.	1.1	.	.	$+^{2}$	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Character taxa of Phragmitetea																												
	Phragmites australis	2.1	+.1	2m.1	.	.	.		.	.	.	2.1°	1.1	2.1	.	.	.	.	.	.	2m.3	.	.	.	.	.	2m.2	.	.
	Eleocharis palustris ssp. palustris	.	.	.	.	.	.	$+^{2}$	.	.	.	.	.	.	.	1.2	.	.	.	.	.	1.1	.	.	.	.	.	.	.
	Cladium mariscus	.	.	2a.2	.	.	.		.	.	.	2.2°	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Differentials of Agropyro-Rumicion crispi																												
	Agrostis stolonifera	+.1	.	.	1.2	.	1.2	$+^{2}$	+.1	1.2	.	.	.	.	.	.	.	1.1	+.1	.	.	+.2	.	.	.	.	.	.	.
	Hydrocotyle vulgaris	1.2	+.1	+.2	.	.	.	$+^{1}$	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	2b.2	.	.	.	.	2a.2
	Other phanerogamic companions																												
	Molinia caerulea	.	.	.	.	.	.		+.1	1.1	.	+.2	1.2	.	+.2	.	+.2	+.2	.	.	+.2	.	.	1.2	.	.	1.3	.	.
	Anagallis tenella	.	.	+.2	1.2	.	.		.	.	.	+.2	.	1.1	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.
	Juncus articulatus	.	.	.	3.3	+.1	.	$+^{2}$	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+.1	.	.	.	.	.	.
	Carex serotina	.	.	.	.	.	.		.	.	.	+.1	.	.	.	.	1.2	4.2	+.2	.	.	2a.2	.	.	.	.	.	.	.
	Mentha aquatica	.	+.1	1.1	+.1	.	.	$+^{1}$	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Carex panicea	.		.	1.1	.	.	$+^{1}$	1.1	.	.	.	.	+.2	(1.1)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Myrica gale	.	.	2.1	.	.	.		+.1	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.
	Utricularia neglecta	.	.	.	.	.	.		.	.	.	.	1.1	.	.	.	.	.	.	2a.2	.	.	+.1	.	.	.	.	.	.
	Schoenus nigricans	.	.	.	.	.	.		1.2	.	.	+.2	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bryophytes																												
	Sphagnum crassicladum	1.3	.	.	.	.	.		1.2	.	5.5	.	.	1.2	.	1.2	.	.	.	.	1.2	.	.	.	.	.	.	.	1.3
	Sphagnum auriculatum	.	.	.	.	.	+.1		.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	4.4	.	3.3	.	1.2	.
	Scorpidium scorpioides	.	.	.	.	.	.		5.4	.	.	2.2	.	3.4	.	5.5	.	.	.	.	.	.	.	.	.	.	.	.	.

Recorded once or twice

Agrostis canina 1.1 (23), +.1 (26)
Alisma plantago-aquatica 1.2 (24)
Caltha palustris +.1 (18)
Carex echinata 1.3 (22)
Carex lasiocarpa 3.2 (1), 2m.3 (26)
Carex rostrata 1.2 (20)
Drosera anglica 1.2 (11)
Drosera intermedia +.2 (8), 1.1 (11)
Drosera rotundifolia +.1 (26)
Equisetum fluviatile 2m.2 (2), +.1 (20)
Galium palustre +.1 (18), +.1 (20)
Glyceria fluitans +.1 (28)
Iris pseudacorus +.1 (15)
Leontodon autumnalis +.1 (17)
Lythrum salicaria +.1 (13)
Myosotis caespitosa 1.2 (21)
Myriophyllum alterniflorum 4.5 (15)
Potentilla palustris +.1 (2), +.2 (4)
Rhynchospora alba +.2 (11)
Samolus valerandi 1.1 (11), 1.1 (21)
Scirpus cernuus +.2 (7), 1.1 (21)
Scirpus lacustris ssp. lacustris +.1-2 (2)
Sparganium emersum +.2 (7)
Triglochin palustris +.1 (8), 2m.1 (21)

Bryophytes and algae

Bryum pseudotriquetrum +.2 (3), +.2 (13)
Calliergon cordifolium +.2 (8)
Campylium stellatum +.2 (4)
Chara spec. 1.3 (7)
Riccardia multifida +.3 (13)
Riccardia pinguis 2m (15)
Sphagnum cuspidatum 3.3 (22), 2b.3 (26)
Sphagnum inundatum + (10), +.2 (22)
Sphagnum palustre 1.2 (26)
Sphagnum compactum 1.2 (19)
Sphagnum subsecundum 1.2 (26)

D = differential taxa of subassociations and variants
△ = geographical differential taxon
L = character taxa of order Littorelletalia
LI = character taxa of alliance Lobelia-Isoetion
Cl = character taxon of class Littorelletea
U = character taxa of order Utricularietalia intermedio-minoris
A = character taxon of other Littorelletea associations
E = character taxa of alliance Eleocharition acicularis

authors

W = v. Westhoff
S = M. Schoof - van Pelt

table 14
Pilularietum globuliferae

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
subunit number		I		II						III										IV									V					
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
country	N	N	N	I	I	N	N	N	N	F	N	N	N	N	N	N	N	N	N	N	N	F	F	F	N	N	N	N	N	N	N	N	N	N
author	Si	D	D	W	W	Si	D	S	D	S	S	G	S	W	S	S	S	S	S	G	S	S	S	S	W	W	W	W	W	W	W	W	W	W
year	42	39	39	68	68	42	39	69	39	69	69	59	69	45	71	71	69	69	69	57	69	69	69	69	39	38	39	39	38	38	38	38	38	38
quadrat size (m^2)	20	1	2	4	.	.	10	4	8	1	1	4	6	20	1	1	1	1	4	15	4	3	2	3	.	1	10	4	1	1	1	1	1	1
cover %	70	.	.	70	90	.	.	90	.	40	50	100	100	100	90	90	90	100	95	100	80	90	40	90	60	100	80		100	100	60	100	100	100
water depth (cm)	-10	.	-	-	-	-	0	0-5	.	0-10	0	25	2--2	10	1	0	0	5--5	5-10	25-30	5-10	1-5	10-15	5-10	3-7	.	0-2	15	-	-	.	20	.	.
number of taxa	23	13	17	16	8	12	20	18	17	13	13	17	21	19	6	6	9	6	7	10	5	8	5	10	9	11	14	8	8	7	13	6	7	26
Character taxon of association																																		
Pilularia globulifera	1.3	3.4	3.4	3.3	5.5	1.2	3.4	5.5	3.4	2m.2	1.2	5.5	4.5	2.2	4.4	5.5	5.5	4.4	5.5	4.5	5.5	2m.5	2m.5	4.4	3.4	+.2	1.1	4.5	4.3	3.3	1.3	4.5	3.3	1.3
Character taxon of Eleocharetum acicularis																																		
D Eleocharis acicularis	2.2	1.2	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Isoëto-Lobelietum																																		
D Subularia aquatica	.	.	.	2m.2	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Eriocaulon septangulare	.	.	.	1.2	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Eleocharetum multicaulis																																		
D Scirpus fluitans	.	+.2	.	+.2	.	.	2.4	1.3	2.4	1.3	+.2	2.3	.	.	.	+.2	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Eleocharis multicaulis	+.2	.	+.2	.	.	+.2	.	+.3	3.3	.	+.2	1.2	1.3	4.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Hypericum elodes	.	+.2	.	.	.	+.2	+.2	.	3.3	.	2a.2	2.2	1.1	.	+.1	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus ololeucos	.	.	.	.	.	.	+.2	1.2	.	.	.	.	2m.2	.	+.1	.	+.1	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton polygonifolius	.	.	.	.	+.2	.	1.2	.	1.2	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.
Deschampsia setacea	.	.	.	.	.	.	1.2	.	.	.	.	1.2	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinodorus repens	.	.	.	.	.	.	.	.	.	2a.2	1.1	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																																		
F D Apium inundatum	.	+.1	.	+.2	+	2.2	2.2	1.2	2.2	.	+.1	1.2	+.1	4.3	.	.	.	.	.	.	.	.	.	.	2.2	1.1	2.3	2.2	+.1	4.2	1.1	2.3	4.2	1.1
L D Littorella uniflora	+.2	2.2	.	1.1	.	.	.	.	1.3	.	.	2.4	.	4.5	.	.	.	.	.	1.3	.	.	.	.	1.2	5.4	1.1	2.2	1.2	.	3.3	1.2	1.3	3.3
E D Echinodorus ranunculoides	.	+ 2	2.2	+.2	1.1	.	3.2	.	1.2	.	.	+.1	.	+.2	.	.	.	.	.	.	.	.	.	.	+.1	1.1	+.2	+.1	+.2	1.1	.	+.2	1.1	.
Cl Juncus bulbosus	1.2	2.2	1.2	2m.1	1.2	3.3	2.2	2m.2	2.4	1.3	3.3	3.3	2b.2	1.2	2.2	1.2	.	.	+.1	2.2	.	3 3	2m.3	1.3	1.1	+.1	+.2	.	.	.	+.1	.	.	+.1
L Elatine hexandra	+.2	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Luronium natans	3 3	.	.				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LI Isoetes lacustris	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Sparganium minimum	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Sparganium angustifolium	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character and differential taxa of Agropyro-Rumicion crispi																																		
Hydrocotyle vulgaris	+.2	.	+.2	.	.	1.2	.	1.2	.	.	.	.	2a.2	1.2	.	.	2b.2	1.2	+.1	+.2	+.2	.	.	.	+.1	+.2	3.3	+.2	+.1	2.2	2.2	+.1	2.2	2.2
Agrostis stolonifera	+.2	.	.	.	.	+.2	.	.	.	1.3	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	1.2
Agrostis canina	+.2	.	.	.	.	+.2	.	.	.	.	+.1	.	.	.	.	+.1	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus effusus	+.2	.	.	.	.	.	.	.	.	+.1	.	.	.	+.1	.	.	.	.	.	.	.	2m.2	.	1.3	.	.	.	.	.	.	.	.	.	.
Myosotis caespitosa	.	.	.	.	.	.	.	.	+.2	.	.	+.1	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.
Character taxa of Phragmitetea																																		
Eleocharis palustris ssp. palustris	1.2	.	.	+.2	.	.	+.2	2m.2	1.2	.	.	.	2m.2	.	.	.	.	+.1	.	2.2	.	.	.	.	+.1	1.2	3.5	3.3	3.3	4.3	.	2.3	4.3	.
Glyceria fluitans	.		1.2	.	.	+.2	1.2	.	.	.	.	+.2	+.1	.	.	.	2a.2	.	1.2	1.2	1.2	1.2	+.1	+.2	.	.	.	+.1	+.1	.	.	.	.	.
Alisma plantago-aquatica	+	.	.	.	.	.	+.1	2a.2	+.2	.	.	1.1	1.1	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phragmites australis	3.2°	.	.	.	.	.	.	+.1	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	2.1	.	.	2.2
Equisetum fluviatile	.	.	.	.	.	.	1.1	+.2	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycopus europaeus	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	+.1	.	.	+.2	.	.	.	.	.	.	.
Other phanerogamic companions																																		
Ranunculus flammula	.	.	+.1	1.1	.	+.2	2.3	1.2	+.2	1.2	1.1	+.1	1.1	2.2	+.1	+.1	.	.	1.1	+.2	.	1.2	+.1	1 1	.	.	+.1	+.1	.	.	+.1	.	.	+.1
Galium palustre	+.2	.	+.2	+.1	+.1	.		+.1	1.2	.	.	.	+.1	.	+.2	.	1.2	.	.	.	.	+.1	.	1.1	.	.	.	.	.	.	.	.	.	.
Juncus articulatus	.	.	.	.	.	.	+.1	.	.	+	+.2	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	+.1
Alopecurus aequalis	.	.	1.2	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	+.2	1.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardamine pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.			.	+.1	.	.	.	+.1	1.1	.	1.2	.	.	.	.	.	.	.	.	.	.
Callitriche spec.	.	.	1.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.
Carex serotina ssp. pulchella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+.1	.	.	+.1
Juncus mutabilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	.	+.1	.	.	+.1
Lythrum salicaria	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	+.1
Mentha aquatica	.		.	.	.	.	.	.	+.1	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.
Peplis portula	.	.	2.2	.	.	.	.	2a.2	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	.	+.2	.	+.2	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryophytes and algae																																		
Calliergonella cuspidata	.	1.2	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	+.2
Drepanocladus fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b.2	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filamentous algae	.	.	.	.	.	.	x	x	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x

Recorded once or twice

Anagallis tenella +.1 (14)
Bidens tripartitus + (1)
Cardamine amara +.2 (9)
Carex trinervis +.2 (14)
Cicendia filiformis +.1 (34)
Eleocharis palustris ssp. uniglumis 1.2 (31), 1.2 (34)
Empetrum nigrum + (26)
Epilobium palustre 1.1 (1)
Galium constrictum +.1 (10)
Glyceria declinata 2a.2 (10)
Gnaphalium uliginosum 1.2 (6)
Iris pseudacorus +.1 (9)
Juncus bufonius 1.2 (2)
Leontodon autumnalis +.1 (30)
Lotus uliginosus +.1 (8), +.1 (13)
Lysimachia vulgaris +.1 (17)
Molinia caerulea +.2 (12)
Myosotis scorpioides +.2 (8), +.1 (13)
Myrica gale +.1 (34)
Oxycoccus macrocarpos +.1 (34)
Phalaris arundinacea 1.2 (24)
Polygonum amphibium fo. natans +.1 (20), 1.2(27)
Polygonum hydropiper +.1 (2)
Polygonum lapathifolium + (1)
Potentilla palustris +.1 (11), + (26)
Radiola linoides +.1 (34)
Ranunculus baudotii +1 (25), 2.3 (29)
Ranunculus repens +.1 (13)
Rorippa islandica + (1)
Salix cinerea +[k] (1)
Salix repens +.1 (31), +.1 (34)
Senecio aquaticus +.1 (4)
Solanum nigrum +.1 (30)
Sonchus asper + (34)
Stellaria palustris +.1 (10)
Taraxacum spec. + (34)
Trifolium repens +.1 (10)
Typha latifolia +° (1)
Utricularia minor 1.2 (12)
Utricularia neglecta + (8), 1.2 (10)
Veronica scutellata +.1 (3), +.1 (7)

Bryophytes and algae

Aulacomnium androgynum +.3 (3)
Blasia spec. +.2 (4)
Bryum spec. +.2 (34)
Calliergon cordifolium 2.a (23)
Calliergon stramineum 1.2 (3)
Chara spec. + (7)
Drepanocladus spec. +.2 (34)
Drepanocladus vernicosus 3.3 (2)
Fossombronia cf. pusilla +.2 (34)
Leptodictyum reparium +.1 (11)
Pellia epiphylla +.3 (3)
Riccardia sp. +.2 (34)
Riccia fluitans +.2 (2)
Scorpidium scorpioides 2.2 (12)
Sphagnum palustre +.2 (3)
Sphagnum spec. + (6)

D = differential taxa of subassociations and variant
E = character taxa of alliance Eleocharition acicularis
L = character taxa of order Littorelletalia
Cl = character taxon of class Littorelletea
LI = character taxon of alliance Lobelio-Isoetion
A = character taxa of other Littorelletea associations

authors

Si = G. Sissingh
D = W.H. Diemont
W = V. Westhoff
S = M. Schoof- v. Pelt
G = P. Glas

countries

N = The Netherlands
I = Ireland
F = France

table 15

Eleocharetum acicularis

table 15

Eleocharetum acicularis

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	subunit number					I								II							III					IV	
	relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	country	N	N	N	N	F	F	I	I	I	N	N	N	N	N	N	N	F	N	N	N	N	N	N	N	N	N
	author	Si	Si	Si	D	S	S	S	S	S	Si	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	year	42	42	43	39	69	69	69	68	68	42	70	69	70	70	70	70	69	70	70	68	70	70	70	70	70	71
	quadrat size (m^2)	5	5	10	.	3	3	4	4	4	.	1	3	2	4	1	1	2	3	3½	9	4	1	2	½	1	1
	cover %	80	100	100	.	15	95	60	60	40	.	50	30	100	90	70	60	90	80	90	90	40	90	90	80	90	90
	water depth (cm)	5	5-15	20-50	2	10-20	1-10	2	-	-	-1	-	-	-	-	-	-	-	20	0-10	30-40	10	0- -	0-7	2	-	5
	number of taxa	14	7	10	14	5	13	15	6	21	14	12	14	9	5	8	7	18	9	6	6	4	5	3	6	4	5
	Character taxon of association																										
	Eleocharis acicularis	3.4	5.5	3.4	2.3	1	5.5	2b.3	3.5	1.2-4	5.5	1.3	2m.3	5.5	4.4	2b.2	3.3	+.3	2b.2	5.5	2b.5	2b.2	2m.2	5.5	2b.2	5.5	5.5
	Differentials of variants																										
E D	Echinodorus ranunculoides	2 2	1.1	.	2.1	2.2	.	1.2	1.1	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A D	E. repens	.	.	.	.	.	.	.	.	.	2.2	1.1	1.1	+.1	1.2	3.2	2a.2	2a.2	+.1	.	.	.	.	.	.	.	.
PL D	Myriophyllum alterniflorum	.	(+)	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	2a.2	+.1	3.5	1.2	+.1	+.1	.	.	.
	Character taxa of other Littorelletea syntaxa																										
L	Littorella uniflora	.	.	+.2	(1.4)	1.2	.	1.2	2m.2	.	.	1.2	2a.3	1.3	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Cl	Juncus bulbosus	+.2	+	.	2.2	.	.	.	.	.	+.2	1.2	.	.	+.1	.	.	1.2	.	.	.	.	.	.	.	.	.
L	Elatine hexandra	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	1.2	+.2	.	1.3	1.2	.	.	.	.	3.3	.	.
L	Luronium natans	.	.	+.2	.	.	1.1	.	.	.	.	.	.	+.1	.	.	.	.	.	.	1.1	.	1.1	.	.	.	.
E	Apium inundatum	+°	.	.	+.2	.	.	2a.3	.	2b.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Potamogeton polygonifolius	2.2	2.3	1.2	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Eleocharis multicaulis	+.2	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Scirpus fluitans	.	.	.	3.3		.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.
A	Sparganium minimum	.	.	.	.	.	.	.	.	.	2.2	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Pilularia globulifera	.	.	(+.2)	+.2	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
△	Juncus heterophyllus	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Character taxa of Phragmitetea																										
	Eleocharis palustris ssp. pal.	.	4.5	.	+.2	2m.2	.	.	1.2	2m.2	3.2	.	1.3	.	.	.	.	2m.2	.	r.1	.	.	.	.	+.1	+.1	.
	Alisma plantago-aquatica	.	1.1	.	.	.	.	2a.2	.	+.1	.	.	.	.	.	.	r.1	+.1	+.1	r.1	.	.	.	.	+.1	.	.
	Phragmites australis	.	.	2 1	.		1.1	.	.	.	.	1.2	+.1°	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.
	Glyceria fluitans	.	.	.	+.2	+.1	1.1	2a.3	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	2b 2
	Lycopus europaeus	.	.	.	.	.	+.1	.	.	.	.	.	+.1	.	.	r.1	r.1	.	.	.	.	.	.	.	.	.	.
	Carex rostrata	+	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.
	Glyceria maxima	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1
	Equisetum fluviatile	.	.	.	.	.	.	2m.2	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Myosotis scorpioides	.	.	.	.	.	.	+.1	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Character and differential taxa of Agropyro-Rumicion crispi																										
	Agrostis stolonifera	1.2	.	.	.	.	.	2m.2	.	+.1	.	.	+.1	.	.	.	.	3.3	.	.	.	.	.	.	.	.	.
	Agrostis canina	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r.1	.	.
	Juncus effusus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	+.1	.	.	.	.	.	.
	Veronica scutellata	.	.	.	1.1	.	.	.	.	.	.	.	.		.	.	.	1.2	.	.	.	.	.	.	.	.	.
	Hydrocotyle vulgaris	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
	Character taxa of Potametea																										
	Ranunculus aquatilis	.	2.2	.	.	.	.	1.2	.	.	.	.	+.2	.	.	1.1	.	.	1.2	.	.	+.2	.	.	.	+.1	.
D	Elodea nuttallii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.3	4.4	.	2a.2	4.4	1.1	.	.	.
	Potamogeton natans	.	.	.	.	.	+.1	.	.	+.1	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
	Potamogeton pusillus	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	1.1	.	.	.	1.1	.	.	.	.
	Other phanerogamic companions																										
	Ranunculus flammula	2.2	.	.	1.2	.	.	.	.	+.1	+	.	+.1		.	.	.	1.2	.	.	.	.	.	.	.	.	+.1
	Galium palustre	.	.	.	+.2	.	.	+.1	.	+.1	.	.	.		.	.	.	1.2	.	.	.	.	.	.	.	.	.
	Mentha aquatica	+	.	(+.2)	.	.	+.1	1.2	.	.	.	.	.		.	.	.	1.2	.	.	.	.	.	.	.	.	.
	Gnaphalium uliginosum	.	.	.	.	.	.	.	.	.	.	+.1	.		.	r.1	r.1	.	.	.	.	.	.	.	.	.	.
	Bidens tripartitus	.	.	.	.	.	.	.	.	.	.	.	.		.	+.1	+.1	.	.	.	.	.	.	.	.	r.1	.
	Cardamine pratensis	.	.	.	.	.	.	+.1	.	.	+	.	.	r 1	.	.	.	.	.	.	.	.	.	.	.	.	.
	Peplis portula	.	.	.	.	.	+.1	.	.	.	.	.	.		.	.	.	.	.	.	2a.3	.	.	.	.	.	.
	Lysimachia vulgaris	+	.	.	.	.	.	.	.	.	.	.	+.1		.	.	.	.	.	.	.	.	.	.	.	.	.
	Carex serotina	2.2	.	.	.	.	.	.	.	.	.	+.1	.		.	.	.	.	.	.	.	.	.	.	.	.	.
	Lemna minor	.	.	.	.	.	1.1	.	.	.	.	.	.	5 5	3.3	.	.	.	.	.	.	.	.	.	.	.	.
	Bryophytes and algae																										
	Nitella spec.	.	.	+.1	.	.	.	.	.	.	+.3	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
	Chara spec.	.	.	+.2	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	1.1
	Calliergonella cuspidata	.	.	.	1.3	.	.	.	.	.	x	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
	Fontinalis antipyretica	.	.	1.1	.	.	.	.	.	+.1	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.

D = differential taxon of subassociations and variants
E = character taxa of alliance Eleocharition acicularis
A = character taxa of other Littorelletea associations
PL = characteristic of both Potametea and Littorelletea
L = character taxa of order Littorelletalia
Cl = character taxon of class Littorelletea
△ = geographical differential taxon

countries
N = The Netherlands
F = France
I = Ireland

authors
Si = G. Sissingh
D = W.H. Diemont
S = M. Schoof - van Pelt

Recorded once
Apium nodiflorum +.1 (9)
Callitriche platycarpa 1.2 (20)
Callitriche spec 2a.2 (6)
Carex disticha +.1 (9)
Cicuta virosa +.1 (9)
Elodea canadensis + (10)
Hottonia palustris +.2 (4)
Hydrocharis morsus-ranae + (10)
Juncus articulatus +.2 (12)
Juncus bufonius 1.2 (11)
Ludwigia palustris 1.3 (6)
Lysimachia thyrsiflora 1.1 (1)
Myosotis caespitosa +.2 (10)
Myriophyllum spicatum 1.2 (3)
Nasturtium microphyllum +.1 (9)
Oenanthe fistulosa +.1 (9)
Polygonum amphibium fo. terrestre 1.2 (9)
Polygonum +.1 (7)
Potamogeton crispus 1.1 (18)
Potamogeton friesii 1.1 (3)
Potamogeton gramineus 1.1 (8)
Potamogeton obtusifolius 3.3 (10)
Potamogeton spec. +.1 (13)
Potentilla anserina 2b.2 (17)
Rorippa sylvestris +.1 (9)
Scirpus americanus +.1 (6)
Trifolium repens +.1 (17)
Typha latifolia r (24)
Veronica catenata +.1 (7)

Bryophytes and algae
Bryum pseudotriquetrum +.1 (9)
Drepanocladus vernicosus 1.2 (9)
Riccia spec. +.2 (11)
filamentous algae 5.5 (8)

table 16

Samolo-Littorelletum

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
country	N	N	N	N	N	N	N	F	F	F	F	F	F	F	F	F	I	I	I	I	I	I	I	I	I	I
author	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	W	S
year	68	70	68	70	68	70	70	69	69	69	69	69	69	69	69	69	68	69	69	69	69	69	69	69	69	69
quadrat size (m^2)	7½	1	2	1	1	1	3	4	1½	1½	9	4	4	2	2	3	1	4	4	1	1	2	4	4	20	4
cover %	100	40	95	80	90	70	80	100	100	80	100	95	30	90	100	95	50	90	100	80	80	10	90	50	80	80
water depth (cm)	15	-	0	-	30	-	-	5	5	0-5	5	10-15	5-25	5-10	5	-	-	5-15	-	-	-	-	2	-	3	0-5
number of taxa	12	12	9	8	15	12	8	12	8	13	12	8	9	9	16	14	16	3	16	12	13	3	8	9	15	7
Differentials of association																										
Samolus valerandi	.	.	.	.	.	2a.2	.	.	+.1	+.1	1.1	.	.	.	1.1	.	1.1	+.1	+.2	1.2	2a.3	1.2	1.2	+.1	2.2	.
Potamogeton gramineus	2a.2	.	.	.	.	.	.	.	.	.	1.1	1.2	.	3.3	1.1	.	.	.	1.2	1.2	1.2	.	+.2	2b.2	2.2	+.1
Carex serotina ssp. pulchella	.	2a.2	.	1.1	.	1.1	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chara spec.	.	.	.	.	1.2	.	.	+.1	5.5	.	5.5	.	.	2a	5.5	.	.	.	x	.	.	.	.	.	2.3	2a.2
Carex trinervis	1.2	.	2b.3	.	3.3	+.1	.	2m.2	2m.2	.	2m.3	2m.2	.	2m.1	2m.2	.	.	.	.	.	.	.	.	.	.	.
Salix repens	.	+.1	.	.	+.1	+.1	.	+.1	1.1	.	1.2	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Littorelletea syntaxa																										
Littorella uniflora	5.5	2b.2	+.2	5.5	.	2b.2	2b.3	5.5	.	2m.2	2m.2	5.5	2m.2	3.3	2m.2	4.4	3.4	5.5	2m.2	2b.3	.	2a.3	3.3	2m.2	2.2	3.3
Echinodorus ranunculoides	.	+.1	.	.	+.1	.	2b.2	.	.	3.3	+.1	.	.	.	2m.2	+.1	+.1	.	2m.3	2m.3	1.2	.	1.3	2m.2	1.1	1.2
Juncus bulbosus	.	.	4.4	.	.	.	1.2	+.1	1.2	.	2m.2	.	.	.	.	.	.	1.2	2m.3	1.2	1.2	.	2m.2	.	4.4	.
Apium inundatum	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	1.2	2a.2	2b.3	.	.	.	1.2	.
Eleocharis multicaulis	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.
Potamogeton polygonifolius	+.1	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luronium natans	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sparganium minimum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.3	.	.	.	.	.
Cormophytic companions																										
Mentha aquatica	+.1	1.2	.	+.1	r.1	1.1	1.2	1.2	1.1	+.1	1.1	1.1	1.2	1.2	1.1	1.2	1.2	.	1.2	2a.2	.	.	.	2a.2	1.1	.
Hydrocotyle vulgaris	r.1	2a.2°	+.2	1.2	.	2b.2	.	+.1	1.1	2a.2	+.1	+.1	1.1	+.1	1.2	+.1	2a.2	.	1.2	1.2	+.2	.	.	.	.	.
Eleocharis palustris ssp. palustris	+.2	r.1°	1.2	.	+.1	.	3.2	1.2	2m.2	1.2	+.1	+.1	.	1.1	2m.2	.	.	.	2a.3	2m.2	2a.3	.	.	.	1.2	2m.3
Differentials of Dutch and French relevés																										
Lycopus europaeus	.	.	.	.	.	r.1	+.1	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.
Lemna trisulca	.	.	.	.	+.2	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Utricularia neglecta	.	.	.	.	5.5	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differentials of French and Irish relevés																										
Juncus articulatus	.	.	.	.	.	.	.	.	.	1.2	.	.	+.2	1.2	.	1.2	1.2	.	1.2	2m.3	2a.3	.	1.2	+.1	1.2	.
Agrostis stolonifera	.	.	.	.	.	.	.	.	.	2m.2	.	.	1.2	1.1	1.1	2m.2	+.1	.	2a.2	.	.	.	1.2	.	2.3	.
Teucrium scordium	.	.	.	.	.	.	.	2a.2	.	.	.	1.1	1.2	.	1.1	1.2	.	.	.	.	.	.	.	1.1	.	.
Carex serotina	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	1.1	2a.2	.	.	.	.	2m.2	.	+.1	.	.
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	+.1	.	.	.	.	.	.	.	.	+.2	.
Anagallis tenella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	+.1	.	.	.	.	.	.	.	.	.
Leontodon autumnalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	+.1	.	.	.	.	.	.	.	.	.
Differentials of Dutch and Irish relevés																										
Ranunculus flammula	+.1	.	+.2	+.1	+.1	.	+.1	.	.	.	.	.	.	.	.	.	+.1	.	2a.3	.	.	.	.	.	1.1	.
Potentilla anserina	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.
Differentials of Dutch relevés																										
Phragmites australis	2m.2	1.2°	.	2a.2	2a.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myrica gale	r.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladium mariscus	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus lacustris ssp. lacustris	.	r.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxycoccus macrocarpos	.	.	r.1°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla palustris	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alisma lanceolata	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lemna minor	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differentials of French relevés																										
Carum verticillatum	.	.	.	.	.	.	.	.	.	+.1	.	.	1.1	.	.	1.2	.	.	.	.	.	.	.	.	.	.
Potentilla anglica	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liparis loeselii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.
Juncus subnodulosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2	.	.	.	.	.	.	.	.	.	.	.
Differentials of Irish relevés																										
Equisetum fluviatile	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2m.2	.	.	.	.	.
Carex panicea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	2m.2	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.
Carex demissa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	1.2	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	+.1	1.2
Myriophyllum alterniflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.2
Bryophytes																										
Drepanocladus aduncus	.	r.1	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Calliergonella cuspidata	.	r.1	.	.	.	.	.	1	.	.	.	.	.	.	.	3.3	.	.	.	.	.	.	.	.	.	.
Campylium stellatum	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum crassicladum	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drepanocladus fluitans	.	.	2b.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Riccardia sinuata	.	r.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium elodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Bryum neodamense	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum marratii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	2b.3	2b.3	.	.
Pellia fabbroniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.
Bryum pseudotriquetrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
Drepanocladus lycopodioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	.	.	.	.	.	.
Campylium polygamum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.

N = The Netherlands
F = France
I = Ireland

authors
S = M. Schoof- v. Pelt
W = V. Westhoff

table 17
Samolo-Littorelletum

		phase of Scirpus maritimus				phase of Carex trinervis			
	author	W	K	K	W	W	W	W	W
	relevé number	1	2	3	4	5	6	7	8
	number of taxa	8	9	12	15	12	17	18	16
	Character taxa of various Littorelletea syntaxa								
L	Littorella uniflora	2.3	2.2	1.2	1.2	1.3	3.3	3.4	3.1
E	Echinodorus ranunculoides	.	+.2	1.2	1.1	.	1.1	+ 1	+.2
Cl	Juncus bulbosus	.	.	.	.	+.2	.	.	.
E	Apium inundatum	.	.		+.1	.	.	.	.
A	Potamogeton polygonifolius + Potamogeton natans	.	.	.	.	.	.	+.1	.
	Differentials of association								
	Samolus valerandi	+.1	1.1	+.1	2.2	.	+.1	+.1	2.1
	Juncus articulatus var. littoralis	+.2	.	.	2.1	.	+.1	1.1	1.1
	Differentials of phase								
	Scirpus maritimus	+.2	1.2	2.2	+.1	.	.	.	.
	Scirpus lacustris ssp. glaucus	+.2	.	1.2	+.1	.	.	.	.
	Agrostis stolonifera var. compacta subvar. arenaria	.	+.2	+.2	1.1	.	.	.	.
	Ranunculus baudotii	1.2	.	1.1	.	.	.	.	.
	Differentials of phase								
	Carex trinervis	.	.	.	.	2.2	2.2	+.1	+.1
	Carex serotina ssp. pulchella	.	.	.	+.1	4.3	+.1	1.1	+.1
	Lythrum salicaria	.	.	.	.	1.1	1.1	+.1	+.1
	Salix repens	.	.	+.1	.	.	+.1	2.1	2.2
	Juncus alpinus ssp. atricapillus	.	.	.	.	+.1	+.1	.	+.1
	Pedicularis palustris	.	.	.	.	+.1	.	+.1	+.1
	Eleocharis palustris ssp. uniglumis	.	.	.	.	.	1.1	1.1	1.1
	Phanerogamic companions								
	Mentha aquatica	.	+.1	+.2	3.2	+.1	2.1	2.1	+.1
	Hydrocotyle vulgaris	.	2.2	1.2	2.1	2.4	2.1	4.5	+.2
	Eleocharis palustris ssp. palustris	1.2	+.1	1.2	1.2	+.2	.	.	+.2
	Ranunculus flammula	.	1.1	+.2	+.2	1.2	1.1	1.1	1.1
	Phragmites australis	.	.	.	2.1	.	+.1	3.2°	1.1
	Utricularia neglecta	.	.	.	.	.	3.2	.	.
	Bryophytes and algae								
	Chara sp.	3.3	.	.	.	.	1.2	+.1	.
	Campylium stellatum	.	.	.	1.2	1.3	.	+.1	.
	Scorpidium scorpioides	.	.	.	.	.	+.2	.	.
	Calliergon stramineum	.	.	.	.	.	.	+.2	.

Legend to table:
rel. 1. Kroonpolder, Terschelling
2. Stuifpolder 8, Vlieland
3 ,, , ,,
4: Buitenste Muy, Texel
5· Klein Badhuisplak, Terschelling
6: Kroonpolder, Terschelling
7 First Kroonpolder, Terschelling
8 Primary dune slack, i.e. of Kroonpolders, Terschelling

L = character taxon of order Littorelletalia
E = character taxa of alliance Eleocharition acicularis
Cl = character taxon of class Littorelletea
A = character taxon of other Littorelletea association

authors
W = V. Westhoff
K = G. Kruseman

table 18

Sparganietum minimi

The Netherlands

subunit						I						II				IIIa			IIIb						IIIc					IIId		
relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
author	Si	Si	Si	Si	Si	Si	Si	Si	Do	Si	Si	D	D	D	S	V	V	Si	BV	Si	G	Si	Si	S	Do	Si	Si	Si	BV	BV	BV	BV
year	43	43	43	43	43	42	43	43	57	43	42	39	39	39	70	59	58	43	59	43	58	43	43	70	57	42	42	42	59	59	59	59
quadrat size (m^2)	.	2	10	.	.	10	.	.	10	.	20	10	10	.	4	4	4	10	1½	32	9	10	10	2	100	.	.	.	3	4	4	1½
cover %	.	80	.	.	.	50	90	.	100	.	30	.	.	.	95	90	65	100	70	.	100	90	30-40	20	100	.	.	90	80	100	80	100
water depth (cm)	.	.	0-15	5-10	5-15	75-100	0	.	.	.	20	.	.	-	-	20	25	50	-2	100	55-60	30	30-40	0-25	30	.	40-50	50-70	55-65	75-80	110-120	65
number of taxa	13	10	9	11	10	4	14	18	10	13	7	16	12	19	18	11	5	10	8	7	8	7	8	4	11	10	11	12	4	4	3	3
Character taxon of association																																
Sparganium minimum	+.2	+.2	+.2	+.2	2.2	2 3	1.1	2.3	1.2	2.2	1.3	1.2	1.1	+.1	+.1	+.2	+.2	2.3	1.2	4.4	4.1	4.5	2.2	1.1	2.2	4.5	4.5	2.3	3.3	1.2	3.2	3.2
Character taxa of order																																
D Utricularia minor	1.2	1.2	+.2	2.3	2.3	2.2	2.3	2.2	2.3	1.3	1.1	.	.	.	.	+.1	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.
D Utricularia intermedia	1.3	2.3	2.2	3.3	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Eleocharetum multicaulis																																
Eleocharis multicaulis	+.2	1.2	3.3	2.3	.	.	.	.	.	.	1.2	2.3	.	.	3.4	2.3	3.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus fluitans	2.2	.	.	.	.	.	.	+.1°	.	1.1	.	2.3	1.3	4.4	.	.	.	3.3	.	.	1.2	+.1	+.2	.	.	.	.	.	.	.	.	.
Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	2.2	+	1.2	1.3	.	.	.	.	3.3	4.4	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum elodes	.	+.2°	.	(+.2)	.	.	.	(+.2)	.	.	.	3.4	.	1.3	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	r.1	.	.	.
Ranunculus ololeucos	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																																
Cl Juncus bulbosus	2.3	+.2	+.2	1.2	1.2	.	1.1	1.2	.	1.2	.	2.2	.	3.3	3.3	1.2	.	+.2	1.2	+.3	.	1.2	2.2	1.2	+.2	.	.	(+)	.	.	1.2	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	+.2	.	1.2	.	1.1	.	1.1	.	.	.	+ 1	.	.	.	.	.	.	3.2	1.1	.	3.3	.	.	.	.
ED Apium inundatum	.	.	.	.	.	.	.	.	.	.	.	1.2	+.2	+.1	2a.1	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
L Littorella uniflora	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
L Luronium natans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	2.2	.	.	.	.	.	.	.
A Pilularia globulifera	.	.	.	.	.	.	.	1.2	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Lobelia dortmanna	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.
A Eleocharis acicularis	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.4	.	.	.	.	.
Character taxa of Phragmitetea																																
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	+.2	+.1	.	+.1	+.1	+.1	1.1	+.1	r.2	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.
Eleocharis palustris ssp. palustris	.	.	.	.	.	.	.	+.3	1.2	.	.	1.2	1.2	+.2	.	.	r.2	.	.	.	r.1	.	.	.	.	1.1	.	.	.	.	.	.
Phragmites australis	1.1°	3.2	.	.	2.5°	.	.	1.1°	.	1.1	.	.	.	.	.	(+.1)	.	.	.	.	.	.	.	.	2.2	1.1	.	.	.	.	.	.
Carex rostrata	3.4	.	.	.	1.2	.	.	+.2	4.5	.	.	.	.	.	.	.	.	+.1	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum fluviatile	.	.	.	.	.	.	.	+	.	.	.	.	+.1	+.2	.	.	.	+.1	.	1.1	+.1	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	1.2	1.2	1.2	1.2	.	.	.	.	.	+.2	.	.	.	.	.	.	+	.	.	.	.
Scirpus lacustris ssp. lacustris	+°	.	.	.	2.3°	.	.	2.3°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia thyrsiflora	+	.	.	.	.	.	.	.	+.1	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Potametea																																
Potamogeton natans	.	1.2	+.2	+.2	.	+.2	.	+.1	.	.	.	.	.	.	+.1	.	.	.	.	.	5.5	1.2	2.3	2b.2	1.2	1.2	+	4.4	4.4	.	.	.
Hydrocharis morsus-ranae	+°	.	.	.	+°	.	.	2.2	.	+.2°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	3.3	.	.	.	.
Elodea canadensis	.	.	.	.	.	.	+.1	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	+	+	2.3	.	.	.	.
Potamogeton gramineus	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	1.2	.	.	2.3	.	.	.	.	.	.
Nymphaea alba	.	(+.2)	.	.	+.2°	.	.	+.2°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.
Nuphar lutea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	+.1	.	.
Other phanerogamic companions																																
PL D Myriophyllum alterniflorum	.	.	.	.	.	.	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	5.5	4.4	4.4
Hydrocotyle vulgaris	+.2	.	.	.	.	.	+.1	.	.	+.1	.	.	.	1.2	1.2	.	.	.	r.1	.	.	.	.	.	+.2	.	.	.	r.1	.	.	.
Carex lasiocarpa	.	3.3	2.2	2.1	.	.	.	.	.	3.3	1.2²	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.
Lemna minor	.	.	.	.	.	+	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	+.2	1.1	1.2	.	.	.	.
Lemna trisulca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.1	+.2	1.1	+	.	.	.	.
D Galium palustre	.	.	.	.	.	.	.	.	.	.	.	+.2	+.2	1.2	.	.	.	(+.1)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Ranunculus flammula	.	.	.	.	.	.	.	.	.	.	.	+.2	.	2.2	+.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium	.	.	1.2	1.1	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+.1	r.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla palustris	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	r.1	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryophytes																																
Scorpidium scorpioides	.	.	.	.	.	.	2.2	.	2.3	2.3	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum cuspidatum	+	.	+.2	.	+.2	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Recorded once or twice

Agrostis canina + (7), 2m.3 (15)
Agrostis stolonifera r.1 (21)
Alopecurus aequalis r.1 (15)
Bidens tripartitus r.1 (15)
Cardamine pratensis +.2 (9)
Carex nigra 1.1 (16), 2.2 (17)
Carex serotina +.2 (4)
Cicuta virosa +.1 (8)
Drosera intermedia + (2)
Drosera rotundifolia + (1)
Echinodorus repens r.1 (19), 3.5 (27)
Equisetum palustre + (11), 2m.2 (24)
Glyceria plicata +.1 (18)
Hottonia palustris 3.3 (13), +.1 (14)
Lycopus europaeus +.1 (9), r.1 (15)
Lythrum salicaria r.1 (15)
Mentha aquatica + (7)
Oenanthe aquatica +.1 (15)
Oenanthe fistulosa +.1 (14)
Potamogeton crispus 1.2 (25)
Potamogeton obtusifolius +.1 (30), 1.2 (32)
Potamogeton cf. pusillus 1.3 (20), 2.3 (29)
Ranunculus aquatilis +.1 (14)
Ranunculus lingua + (8)
Rhynchospora fusca +.2 (4)
Sagittaria sagittifolia + (28)
Sparganium emersum +.2 (28)
Stratiotes aloides +.1 (22), +° (23)
Typha angustifolia 4.5 (7)
Utricularia neglecta 1.1 (18), 1.2 (20)
Utricularia cf. ochroleuca 3.3 (29)
Veronica scutellata +.1 (13), 1.1 (14)

Bryophytes and algae

Anthoceros sp. + (7)
Calliergonella cuspidata +.2 (11), +.1 (14)
Chara sp. 2.2 (7), 5.5 (16)
Drepanocladus fluitans +.3 (18)
Nitella sp. +.2 (28)

D = differential taxa of subassociation or variant
Cl = character taxon of class Littorelletea
E = character taxa of alliance Eleocharition acicularis
L = character taxa of order Littorelletalia
A = character taxa of other Littorelletea associations
PL = characteristic of both Potametea and Littorelletea

authors

Si = G. Sissingh
Do = J. v. Donselaar
D = W.H. Diemont
V = E.E. v.d. Voo
BV = C.A. Bastiaanssen & H.J. Verhoeven
G = P. Glas
S = M. Schoof - van Pelt

table 19

Sphagno-Sparganietum angustifolii

table 19
Sphagno - Sparganietum angustifolii

subunit number	I								
relevé number	1	2	3	4	5	6	7	8	9
country	Sc	Sc	Sc	N	N	N	N	N	I
author	S	S	S	Si	Si	V	Si	V	S
year	69	69	69	43	42	57	43	59	68
quadrat size (m^2)	2	9	16	100	50	4	.	4	.
cover %	50	20	5	.	70	100	.	100	.
water depth (cm)	5-20	30	50	75	5-10	45	100	60	50
number of taxa	6	6	5	5	12	4	3	4	8
Character taxon of association									
Sparganium angustifolium	1.2	2b.2	1.2	3.3	1.3	3.2	3.3	2.3	2m.[2]
Character taxa of Isoëto-Lobelietum									
D Lobelia dortmanna	1.2	1.2	2m.2	+.3	.	.	.	.	.
D Isoetes setacea	.	.	.	.	.	2.2	.	3.2	.
D Isoëtes lacustris	.	.	.	.	2.1	.		.	.
Character taxa of other Littorelletea syntaxa									
U D Utricularia minor	.	.	.	.	.	.	.	.	.
A D Potamogeton polygonifolius	+.1	.	.	.	.	.	.	.	.
Cl Juncus bulbosus	3.3	2a.2	1.3	+.2	1.2	.	.	.	2a.[2]
L D Luronium natans	.	.	.	1.2	3.3	2.3	+.3	.	.
L Littorella uniflora	.	.	.	+.3	.	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	.	.
L Elatine hexandra	.	.	.	.	2.2	.	.	.	.
E Apium inundatum	.	.	.	.	.	.	.	.	+.[2]
A Eleocharis multicaulis	.	.	.	.	1.2	.	.	.	.
A Scirpus fluitans	.	.	.	+.1	.	.	.	.	.
A Pilularia globulifera	.	.	.	.	1.3	.	.	.	.
Character taxa of Phragmitetea									
Eleocharis palustris ssp. palustris	.	.	.	.	2.1	.	.	.	.
Glyceria fluitans	1.2	.	.	.	.	.	.	(+)	
Carex rostrata	.	+.1	.	.	.	.	.	.	.
Phragmites australis	.	.	.	.	+°	.	.	.	.
Equisetum fluviatile	.	1.2	.	.	.	.	.	.	.
Typha latifolia	.	.	.	.	+°	.	.	.	.
Alisma plantago-aquatica	.	.	.	.	+	.	.	.	.
Cladium mariscus	.	.	.	.	.	.	.	.	.
Character taxa of Potametea									
Potamogeton natans	.	.	.	.	.	.	.	.	.
Polygonum amphibium fo. natans	.	.	.	.	.	.	.	.	.
Utricularia neglecta	.	.	1	.	.	.	.	.	.
Nuphar lutea	.	.	.	.	.	.	.	.	2.[2]
Potamogeton gramineus	.	.	.	.	.	.	.	.	2b.[2]
Potamogeton berchtoldii	.	.	.	.	.	.	.	.	3
Nymphaea alba	.	.	.	.	.	.	+.2	.	.
Myriophyllum verticillatum	.	.	.	.	.	.	.	.	
Other phanerogamic companions									
PL Myriophyllum alterniflorum	.	1.2	1.1	.	.	.	.	.	2[2]
Eriophorum angustifolium	+.1	.	.	.	.	.	.	.	
Peplis portula	.	.	.	.	r	.	.	.	
Carex lasiocarpa	.	.	.	.	.	.	.	.	
Lemna minor	.	.	.	.	.	.	.	.	
Bryophytes and algae									
D Sphagnum crassicladum	.	.	.	.	.	.	.	.	
D Sphagnum cuspidatum	.	.	.	.	.	.		.	
Drepanocladus fluitans	.	.		.	.	3.5	.	4.5	
Scorpidium scorpioides	.	.	.	.	.	.	.	.	
Chara spec.	.	.	.	.	.	.	.	.	

subunit number	II								
relevé number	10	11	12	13	14	15	16	17	18
country	N	N	N	N	N	N	N	I	N
author	D	D	D	V	D	D	V	S	D
year	37	39	37	58	39	37	58	68	38
quadrat size (m^2)	40	10	.	4	10	10	2	100	.
cover %	.	.	.	100	.	.	.	.	.
water depth (cm)	.	.	.	50	30	.	.	100	100
number of taxa	6	8	8	3	8	6	4	10	9
Character taxon of association									
Sparganium angustifolium	4.5	3.4	+.1	3.2	4.5	+.2	2.2	4.4	2.3
Character taxa of Isoëto-Lobelietum									
D Lobelia dortmanna	.	.	.	.	.	.	.	.	.
D Isoetes setacea	.	.	.	.	.	.	.	.	.
D Isoëtes lacustris	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa									
U D Utricularia minor	+.2	.	3.3	5.5	.	4.4	+.2	1.1	2.3
A D Potamogeton polygonifolius	.	1.2	3.3	.	+.2	2.3	.	.	2.4
Cl Juncus bulbosus	1.2	1.2	2.3	+.2	.	1.2	.	.	1.2
L D Luronium natans	.	.	.	.	.	.	.	.	.
L Littorella uniflora	.	.	.	.	.	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	1.2	.	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.
E Apium inundatum	.	.	.	.	.	.	.	.	.
A Eleocharis multicaulis	.	.	.	.	.	.	.	.	.
A Scirpus fluitans	.	.	.	.	1.2	.	.	1.3	.
A Pilularia globulifera	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea									
Eleocharis palustris ssp. palustris	.	2.3	.	.	1.3	.	.	.	.
Glyceria fluitans	+ 2	.	+.1	.	2.2	.	.	.	.
Carex rostrata	(+.2)		.	.	.	.	.	+.2	+.3
Phragmites australis	.	.	.	.	.	.	.	1.2	.
Equisetum fluviatile	.	.	.	.	.	.	.	.	.
Typha latifolia	.	.	.	.	.	.	.	.	.
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	.
Cladium mariscus	.	.	.	.	.	.	.	+.1	.
Character taxa of Potametea									
Potamogeton natans	.	.	.	.	.	.	.	2a.3	.
Polygonum amphibium fo. natans	.	2.2	.	.	2.2	.	.	.	.
Utricularia neglecta	.	.	.	.	.	.	.	.	.
Nuphar lutea	.	.	.	.	.	.	.	.	.
Potamogeton gramineus	.	.	.	.	.	.	.	.	.
Potamogeton berchtoldii	.	.	.	.	.	.	.	.	.
Nymphaea alba	.	.	.	.	.	.	.	+.2	.
Myriophyllum verticillatum	.	.	.	.	.	.	.	.	1.3
Other phanerogamic companions									
PL Myriophyllum alterniflorum	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium	(+.2)	1.1	+.1	.	.	.	.	.	+.1
Peplis portula	.	.	.	.	.	.	.	.	.
Carex lasiocarpa	.	.	.	.	.	.	.	+.1	.
Lemna minor	.	.	.	.	.	.	.	.	.
Bryophytes and algae									
D Sphagnum crassicladum	2.3	3.4	3.4	.	.	3.4	4.5	.	1.2
D Sphagnum cuspidatum	1.2	1.2	2.2	.	2.3	1.2	3.2	.	2.3
Drepanocladus fluitans	.	.	4.4	.	.	.	.	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	5.5	.
Chara spec.	.	.	.	.	.	.	.	.	.

subunit number	III																				
relevé number	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
country	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
author	D	V	V	G	V	V	V	G	G	V	V	V	V	V	G	G	V	V	V	G	V
year	39	58	59	58	59	59	58	58	58	59	59	59	58	59	58	58	59	59	59	58	59
quadrat size (m^2)	50	2	15	9	4	9	4	9	50	4	1	5	4	1	25	100	2	2	4	6	3
cover %	.	100	100	100	70	100	100	100	50	100	100	100	100	20	50	60	100	60	50	30	90
water depth (cm)	.	50	-5	50-60	60	30	60-70	40	90	60	25	50-80	50	40	90	70-80	25-50	50	60	50-80	50
number of taxa	7	4	4	3	3	2	3	4	3	2	3	2	3	2	4	4	4	4	2	2	2
Character taxon of association																					
Sparganium angustifolium	+.2	3.2	1.2	4.2	4.5	4.5	3.2	3.2	3.2	3.4	3.4	3.3	2.2	2.2	2.2	1.1	2.2	4.4	3.3	2.1	2.2
Character taxa of Isoëto-Lobelietum																					
D Lobelia dortmanna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Isoetes setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
D Isoëtes lacustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of other Littorelletea syntaxa																					
U D Utricularia minor	.	.	.	.	.	.	.			.	.	.	.	.	.	.	.	.	.	.	.
A D Potamogeton polygonifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cl Juncus bulbosus	3.3	.	3.3	.	2.2	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	5.5
L D Luronium natans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Littorella uniflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.5	.	.	.	.
E Echinodorus ranunculoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
L Elatine hexandra	.	.	.	.	.	.	.	.	.	.			.	.	.	.	.	.	.	.	.
E Apium inundatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Eleocharis multicaulis	.	.	r.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r.2	.	.	.
A Scirpus fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A Pilularia globulifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																					
Eleocharis palustris ssp. palustris	2.2	.	.	.	.	.	.	+.2	.	.	1.2	.	.	.	.	1.2	.	.	.	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex rostrata	.	r.2	(+.2)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum fluviatile	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Typha latifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladium mariscus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Potametea																					
Potamogeton natans	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	+.2	+.2	.	2.2	.
Polygonum amphibium fo. natans	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	3.2	.	.	.	.	.	.
Utricularia neglecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nuphar lutea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton gramineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton berchtoldii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nymphaea alba	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myriophyllum verticillatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other phanerogamic companions																					
PL Myriophyllum alterniflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peplis portula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex lasiocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lemna minor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r.1	.	.	.
Bryophytes and algae																					
D Sphagnum crassicladum	4.4	5.5	5.5	1.2	+.2	5.5	1.2	4.4	2.2	5.5	5.5	5.5°	+.2	1.2	2.2	2.2	4.5	.	.	.	.
D Sphagnum cuspidatum	3.3	1.2	.	.	.	.	5.5	.	.	.	.	.	5.5	.	.	.	.	.	.	.	.
Drepanocladus fluitans	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	+.2	3.2	.	.	2.4	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chara spec.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

D = differential taxa of subassociations
U = character taxon of order Utricularietalia intermedio-minoris
A = character taxa of other Littorelletea syntaxa
Cl = character taxon of class Littorelletea
L = character taxa of order Littorelletalia
E = character taxa of Eleocharition acicularis
PL = characteristic of both Potametea and Littorelletea

countres
Sc = Sotland
N = Te Netherlands
I = Ieland

authors
S = M. Schoof - van Pelt
Si = G. Sissingh
V = E.E v.d. Voo
D = W H. Diemont
G = P Glas

table 20

synoptic table Littorelletea

	Isoeto-Lobelietum								Eleocharetum multicaulis										Pilularietum globuliferae					Eleocharetum acicularis			S-L	Sparganietum minimi					Sphagno-Sparganietum angustifolii		
column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
subunit number	Ia	Ib	II	III	IV	V	VI	VII	Ia1	Ia2	Ib1	Ib2	IIa1	IIa2	IIb1	IIb2	IIIa	IIIb	III	II	IV	V	I	I	II	III	.	I	II	III	IIIc	IIId	I	II	III
number of relevés	7	43	12	16	19	7	28	51	12	24	10	10	6	5	32	23	36	90	9	2	10	10	3	9	8	6	26	11	4	5	9	3	9	9	21
Character taxa of Isoeto-Lobelietum and Lobelio-Isoetion																																			
Lobelia dortmanna	V^{+-2}	V^{+-5}	V^{+-4}	III^{+-4}	V^{1-4}	III^{+-2}	V^{r-4}	V^{+-4}	.	.	.	.	.	2^{2}	I^{r-1}	.	I^{1}	I^{+-1}	.	.	.	.	.	.	.	.	.	I^{r}	.	.	I^{+}	.	III^{+-2}	.	.
Isoetes setacea	.	.		V^{+-4}	.	I^{+}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II^{2-3}	.	.
Isoetes lacustris	.	.	.	.	V^{1-3}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.	.	.	.	.	.	.	.	.	I^{2}	.	.
Subularia aquatica	.	.	.	.	.	V^{+-2}	.	.	.	.	.	.	.	.	.	.	.	.	.	2^{2}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriocaulon septangulare	V^{1-4}	II^{2-5}	I^{2}	I	I^{1-2}	III^{1-5}	.	II^{1-5}	.	I^{+-2}	II^{+-3}	.	.	.	.	.	.	I^{1-2}	.	2^{+-1}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Eleocharetum multicaulis																																			
Eleocharis multicaulis	.	.	.	I^{1}	I^{+}	.	II^{+-2}	V^{+-3}	III^{1-4}	IV^{+-4}	V^{+-4}	IV^{+-3}	V^{2-4}	5^{2-3}	V^{+-4}	V^{+-4}	IV^{+-4}	V^{r-4}	IV^{+-4}	.	.	.	2^{+}	I^{+}	I^{2}	.	I^{+-1}	III^{+-3}	2^{2-3}	II^{2-3}	.	.	I^{1}	.	I^{r}
Hypericum elodes	.	.	.	.	I^{+}	.	.	I^{+-1}	IV^{+-4}	IV^{1-4}	III^{+-5}	IV^{+-5}	V^{2-3}	3^{1-2}	IV^{+-3}	II^{+-2}	IV^{r-5}	I^{+-3}	IV^{+-3}	.	I^{+}	.	I^{+}	.	.	.	.	I^{+}	2^{1-3}	I^{+}	I^{r}	.	.	.	.
Potamogeton polygonifolius	.	I^{+-2}	.	I^{1}	.	II^{+}	.	I^{+-2}	V^{+-4}	V^{+-5}	V^{+-2}	V^{+-4}	I^{+}	.	I^{1}	.	I^{r}	.	II^{+-1}	I^{+}	.	I^{+}	.	III^{+-2}	.	.	I^{+-1}	I^{+-2}	2^{1}	III^{1-4}	.	.	I^{+}	III^{+-3}	.
Scirpus fluitans	.	I^{1}	.	I^{1}	.	.	.	I^{1-3}	V^{+-5}	V^{+-5}	.	.	V^{+-2}	5^{+-2}	.	I^{+}	V^{+-4}	.	IV^{+-2}	I^{+}	I^{+-1}	.	I^{+}	I^{3}	I^{1}	.	.	II^{+-2}	3^{1-4}	I^{3}	III^{+-1}	.	I^{+}	II^{1}	.
Deschampsia setacea	.	I^{1}	.	.	.	.	I^{+}	I^{+-2}	I^{1}	I^{1}	II^{1}	I^{1}	V^{+-2}	.	V^{+-3}	.	I^{+}	I^{r-1}	II^{+-1}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinodorus repens	.	.	.	.	.	.	.	I^{1-2}	II^{+-2}	II^{+-2}	.	I^{r-+}	.	.	I^{1}	I^{+-1}	I^{1-2}	I^{2}	II^{1-2}	.	.	.	.	.	V^{+-3}	I^{+}	.	.	.	II^{r-5}	.	.	.	.	.
Ranunculus ololeucos	.	.	.	I^{2}	.	.	.	.	.	I^{1}	.	.	I^{1}	.	I^{+-1}	I^{1}	I^{r-2}	I^{r-2}	II^{+-2}	.	II^{+-1}	.	.	.	.	.	.	.	I^{+}	.	.	.	.	.	.
Character taxon of Pilularietum globuliferae																																			
Pilularia globulifera	.	.	.	.	I^{1}	.	.	.	.	.	.	.	I^{+}	I^{2}	I^{+}	.	I^{1}	.	V^{1-5}	2^{3-5}	V^{2-5}	V^{+-4}	3^{1-3}	I^{+}	.	.	.	I^{1}	I^{2}	.	.	.	I^{1}	.	.
Character taxon of Eleocharetum acicularis																																			
Eleocharis acicularis	.	.	.	I^{+}	I^{1-2}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3^{1-2}	V^{1-5}	V^{+-5}	V^{2-5}	.	I^{1}	.	.	I^{2}	.	.	.	.
Character taxon of Sparganietum minimi																																			
Sparganium minimum	.	.	.	.	.	.	.	.	.	II^{r-1}	.	I^{1}	.	.	.	.	I^{+}	I^{+}	.	I^{+}	.	.	.	.	II^{+-2}	.	I^{2}	V^{+-2}	4^{+-1}	V^{+-4}	V^{1-4}	3^{1-3}	.	.	.
Character taxon of Sphagno-Sparganietum angustifolii																																			
Sparganium angustifolium	.	.	.	.	I^{+}	.	.	.	.	.	.	.	I^{+}	.	I^{+}	.	.	.	.	.	.	.	I^{1}	.	.	.	.	.	.	.	.	.	V^{1-3}	V^{+-4}	V^{+-4}
Character taxon of Littorelletea																																			
Juncus bulbosus	.	V^{+-3}	V^{+-3}	IV^{+-4}	IV^{+-2}	V^{1-5}	V^{+-4}	IV^{+-4}	IV^{+-3}	V^{+-4}	III^{+-2}	IV^{+-2}	V^{1-3}	5^{1-3}	V^{+-5}	IV^{+-5}	IV^{+-4}	IV^{+-5}	V^{1-3}	2^{1-2}	IV^{1-3}	III^{+-1}	3^{1-2}	II^{+-2}	III^{+-1}	.	III^{+-4}	IV^{r-2}	3^{2-3}	V^{+-1}	IV^{+-2}	I^{1}	IV^{+-3}	IV^{+-2}	II^{+-5}
Character taxa of Littorelletalia																																			
Littorella uniflora	.	IV^{+-4}	V^{1-5}	IV^{+-3}	IV^{+-4}	III^{2}	V^{+-5}	IV^{+-5}	.	I^{1}	.	.	V^{+-4}	5^{+-4}	IV^{r-5}	V^{1-5}	II^{r-1}	I^{+}	II^{1-4}	I^{1}	I^{1}	V^{1-5}	2^{+-2}	III^{+-2}	III^{1-2}	.	V^{+-5}	.	I^{1}	.	I^{+}	.	.	.	I^{5}
Luronium natans	.	I^{+-3}	.	I^{1-2}	II^{+-2}	.	I^{2}	.	III^{+-2}	.	.	.	.	.	I^{+-1}	I^{1-2}	I^{r-2}	I^{+}	.	.	.	.	I^{3}	II^{+}	I^{+}	II^{1}	I^{+}	.	.	.	II^{+-1}	.	III^{+-3}	.	.
Elatine hexandra	.	.	.	I^{1}	II^{+-3}	I^{2}	.	.	.	.	.	.	.	.	.	I^{1}	.	.	.	I^{+}	.	.	I^{+}	.	II^{+-2}	II^{1}	.	.	.	.	.	.	I^{2}	.	.
Character taxa of Eleocharition acicularis																																			
Echinodorus ranunculoides	.	I^{+-1}	I^{+}	I^{1-3}	I^{+-1}	II^{+-2}	.	I^{+}	I^{r-+}	I^{+-2}	.	.	IV^{+-1}	3^{+-2}	II^{+-2}	I^{+-2}	I^{r-2}	I^{1}	III^{+-3}	2^{+-1}	.	IV^{+-1}	2^{+-2}	IV^{+-2}	.	.	III^{+-3}	I^{+-1}	2^{1}	I^{+}	IV^{+-3}	.	.	I^{1}	.
Apium inundatum	I^{1}	I^{+-2}	I^{1}	I^{+}	I^{1}	III^{+}	I^{+}	I^{2}	V^{+-3}	I^{+}	.	.	V^{+-1}	2^{+-2}	II^{+-2}	I^{+-1}	II^{+-4}	.	V^{+-4}	2^{+}	.	V^{1-4}	I^{+}	III^{+-2}	I^{1}	.	I^{+-2}	.	4^{+-2}	.	I^{+}	.	I^{+}	.	.
Character taxa of Utricularietalia intermedio-minoris																																			
Utricularia minor	I^{+}	.	.	.	.	.	.	.	.	.	I^{1}	I^{1}	.	.	I^{+-1}	.	I^{+}	I^{r-1}	I^{1}	.	.	.	.	.	.	.	.	V^{+-2}	.	II^{+}	.	.	.	IV^{+-4}	.
Utricularia intermedia	.	I^{1}	.	.	.	.	.	I^{+-1}	.	I^{1-2}	II^{+-2}	II^{+-2}	.	I^{1}	I^{+-2}	.	.	I^{1-4}	.	.	.	.	.	.	.	.	.	III^{+-3}	.	.	.	.	.	.	.
Character and differential taxa of Agropyro-Rumicion crispi, at the same time differentials of Eleocharition acicularis																																			
Hydrocotyle vulgaris	.	I^{+-2}	.	.	.	I^{+}	II^{+-2}	I^{+-2}	III^{+-1}	IV^{+-3}	.	I^{r-+}	V^{+-3}	2^{+-1}	V^{r-3}	III^{+-3}	III^{+-3}	II^{+-3}	III^{1-2}	.	III^{+-2}	V^{+-3}	2^{+}	.	II^{+-1}	.	IV^{r-2}	II^{+}	2^{1}	I^{r}	II^{r-+}	.	.	.	.
Agrostis canina	.	.	.	I^{+}	.	.	I^{+}	I^{1}	.	II^{+-2}	.	.	II^{+-1}	3^{+-1}	III^{+-2}	II^{+-2}	II^{+-2}	II^{r-2}	II^{+}	.	I^{+-1}	.	I^{+}	I^{1}	.	.	.	I^{+}	I^{2}	.	.	.	.	.	.
Agrostis stolonifera	.	I^{1}	.	.	.	I^{1}	I^{+}	I^{+-2}	II^{1-2}	III^{+-2}	I^{+-1}	.	.	.	I^{1}	II^{+-2}	II^{+-2}	I^{1}	II^{+-1}	.	.	I^{1}	I^{+}	II^{+-2}	II^{+-3}	.	II^{+-2}	.	.	.	I^{r}	.	.	.	.
Juncus articulatus	.	I^{+}	I^{+}	.	.	.	.	I^{1}	I^{2}	I^{+-3}	.	.	.	.	I^{+}	I^{+}	I^{+}	.	III^{+-1}	.	.	I^{+}	.	.	I^{+}	.	III^{+-2a}	.	.	.	.	.	.	.	.
Veronica scutellata	.	.	.	.	.	.	.	.	I^{1}	I^{1}	.	.	II^{1}	I^{1}	.	I^{+}	I^{+-1}	I^{r-1}	I^{+}	.	.	.	I^{+}	I^{1}	I^{1}	.	.	.	2^{+-1}	.	.	.	.	.	.
Juncus effusus	.	.	.	.	.	.	.	.	.	I^{1}	.	.	.	.	I^{+}	I^{+}	.	I^{+-2}	II^{+}	.	I^{1-2}	.	I^{+}	.	I^{1}	I^{+}	.	.	.	.	.	.	.	.	.
Differentials of Samolo-Littorelletum																																			
Samolus valerandi	.	.	.	.	.	.	.	.	.	.	I^{1}	.	II^{1}	I^{2}	.	.	I^{1}	.	.	.	.	.	.	.	.	.	III^{+-2}	.	.	.	.	.	.	.	.
Carex trinervis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.	I^{+}	.	.	.	.	.	.	.	III^{+-3}	.	.	.	.	.	.	.	.
Salix repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I^{+}	I^{2}	.	.	.	.	I^{+}	.	.	.	.	II^{+-1}	.	.	.	.	.	.	.	.
Character taxa of Phragmitetea																																			
Eleocharis palustris ssp. palustris	II^{1-2}	II^{+-2}	I^{1-2}	I^{+-2}	II^{+-1}	.	III^{+-2}	I^{+-2}	III^{1-3}	I^{+-2}	I^{1}	.	II^{+}	.	I^{+-2}	II^{+-2}	II^{+-1}	I^{r-2}	III^{+-2}	I^{+}	I^{+-3}	IV^{+-4}	I^{1}	III^{+-4}	II^{1-3}	I^{r}	IV^{+-3}	I^{+-1}	3^{+-2}	I^{r}	II^{r-1}	.	I^{2}	II^{1-2}	I^{+-2}
Glyceria fluitans	.	.	.	I^{1-2}	I^{r}	.	I^{+-1}	I^{+}	III^{+-2}	II^{+-1}	.	.	III^{+-2}	I^{+}	I^{+-1}	I^{+}	II^{+-2}	I^{+-1}	III^{+-1}	.	IV^{+-2}	I^{+}	I^{1}	III^{+-2}	I^{+}	.	I^{+-1}	.	4^{1}	.	II^{+}	.	I^{1}	II^{+-2}	.
Phragmites australis	I^{+}	I^{1}	.	I	I^{+-1}	I^{1}	I^{1}	I^{r-2}	.	I^{+-2}	III^{+-2}	.	.	.	.	I^{+-1}	I^{+-2}	I^{+-2}	II^{+-1}	.	.	II^{1-2}	I^{3}	II^{1-2}	II^{+-1}	.	I^{1-2}	III^{1-3}	.	.	II^{1-2}	.	I^{+}	I^{1}	.
Alisma plantago-aquatica	.	.	.	.	I^{+}	.	.	I^{+}	.	I^{+}	.	.	I^{+}	2^{+}	II^{r-1}	I^{r}	I^{+-1}	I^{r-2}	III^{+-2}	.	I^{2}	.	I^{+}	II^{+-2}	II^{r-+}	II^{r-+}	.	I^{+}	4^{+-1}	II^{r-+}	I^{1}	.	I^{+}	.	.
Carex rostrata	.	I^{+-2}	.	I	.	I^{1}	I^{+-2}	I^{+-2}	.	.	I^{1-2}	II^{r-1}	.	.	.	.	I^{+-1}	I^{r-2}	.	.	.	.	.	I^{+}	I^{1}	.	.	II^{+-4}	.	II^{+-1}	.	.	I^{+}	II^{+}	I^{+}
Equisetum fluviatile	I^{1}	I^{+-2}	III^{1-2}	.	.	I^{1}	.	I^{r}	.	I^{+}	.	.	II^{+}	I^{1}	.	.	I^{+-1}	I^{1-2}	II^{+-1}	.	.	.	.	II^{1-2}	.	.	I^{1-2}	I^{+}	2^{+}	II^{+-1}	I^{+}	.	I^{1}	.	.
Lycopus europaeus	.	.	.	.	.	.	.	.	.	II^{+}	.	.	.	.	I^{r-+}	II^{r-+}	I^{r-+}	I^{+}	I^{+}	.	I^{+}	I^{+}	.	I^{+}	II^{r-+}	.	I^{r-+}	I^{+}	I^{r}	.	.	.	.	.	.
Cladium mariscus	II^{2}	I^{1}	.	I	.	.	.	.	.	I^{2}	I^{+-2}	.	.	.	I^{r}	.	.	.	.	.	.	.	.	.	.	.	I^{+}	.	.	.	.	.	.	I^{+}	.
Iris pseudacorus	.	.	.	.	.	.	I^{+}	I^{+}	.	I^{+-1}	I^{+}	.	.	.	I^{r-+}	.	.	I^{+}	I^{+}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Character taxa of Potametea																																			
Potamogeton natans	II^{2}	I^{1-4}	I^{2}	II^{+-2}	.	I^{2}	.	I^{+-2}	.	.	.	.	.	.	I^{+-2}	I^{+}	I^{+-4}	I^{+-1}	II^{+}	.	I^{1}	.	.	II^{+}	.	.	.	III^{+-1}	I^{+}	.	V^{+-5}	.	.	I^{2}	I^{+-2}
Potamogeton gramineus	.	I^{1}	I^{1}	I^{1}	.	.	.	I^{+}	.	.	.	.	.	.	I^{2}	.	.	.	.	.	.	.	.	I^{1}	.	.	III^{+-3}	I^{+}	.	.	III^{+-2}	.	I^{2}	.	.
Polygonum amphibium fo. natans	.	.	.	I^{+}	I^{+}	.	I^{+}	.	I^{+}	I^{+}	.	.	II^{+}	.	.	I^{+-1}	I^{r-+}	.	.	.	I^{+}	I^{1}	.	.	.	.	.	.	.	.	.	.	.	II^{2}	I^{+-3}
Utricularia neglecta	.	II^{+-1}	.	.	I^{+}	.	.	I^{+-1}	I^{1}	I^{+-1}	I^{1}	.	.	.	.	.	I^{+-2}	I^{4}	II^{+-1}	.	.	.	.	.	.	.	I^{+-5}	.	.	I^{1}	.	.	I^{1}	.	.
Ranunculus aquatilis	.	.	.	I^{+}	I^{2}	.	.	.	III^{+-1}	I^{1}	.	.	.	I^{+}	.	.	I^{+}	.	.	.	.	.	.	II^{1-2}	II^{+-1}	II^{+-1}	.	.	I^{+}	.	.	.	.	.	.
Nymphaea alba	.	I^{1}	.	.	.	.	I^{r}	I^{+-2}	.	I^{+}	.	I^{2}	.	.	.	.	.	I^{r-1}	.	.	.	.	.	.	.	.	.	I^{+}	.	.	I^{+}	.	I^{+}	I^{+}	I^{1}
Callitriche spec	.	I^{+}	.	.	I^{1}	I^{+}	.		II^{1-2}	.			.		.		I^{+}	.	.	I^{1}	I^{+}	.	I^{1}	I^{2}	.	I^{1}	.	.	.	.	.	.	.	.	.
Character taxa of Parvocaricetea																																			
DEa Ranunculus flammula	.	I^{+-1}	II^{+-2}	I^{1}	.	III^{+-1}	.	I^{+-2}	III^{+-2}	IV^{+-2}	III^{+-3}	.	V^{+-2}	3^{1-2}	III^{+-2}	III^{+-2}	III^{r-2}	I^{+-2}	V^{+-2}	I^{1}	IV^{+-1}	II^{+}	I^{+}	II^{+-2}	II^{+-1}	.	II^{+-2}	.	3^{+-2}	.	.	.	.	.	.
Eriophorum angustifolium	.	.	.	.	.	.	I^{1}	I^{+-2}	I^{1}	I^{+}	II^{+-1}	II^{+-1}	II^{1}	2^{+}	II^{+-2}	.	I^{+}	II^{r-2}	.	.	.	.	.	.	.	.	.	I^{1}	.	I^{1}	.	.	I^{+}	II^{+-1}	.
Carex lasiocarpa	.	I^{1-2}	.	.	.	.	.	I^{+-2}	.	I^{2}	.	V^{+-3}	.	.	I^{+-2}	.	.	I^{+-4}	.	.	.	.	.	.	.	.	.	III^{+-3}	.	I^{1}	.	.	.	I^{+}	.
Potentilla palustris	.	I^{+}	.	.	.	.	I^{1}	.	I^{+}	I^{+}	.	.	I^{+}	.	I^{+}	.	I^{+-2}	I^{r-+}	I^{+}	.	.	I^{1}	.	.	.	.	I^{1}	I^{+}	I^{r}	I^{+}	.	.	.	.	.
Menyanthes trifoliata	II^{+-1}	I^{+-2}	.	.	.	.	.	I^{+-1}	.	I^{+-2}	I^{+-2}	.	.	.	.	.	.	I^{+-2}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex nigra	.	I^{1-2}	.	.	.	.	.	I^{+-2}	.	I^{+}	II^{+-1}	.	.	.	I^{r-1}	.	.	I^{1-2}	.	.	.	.	.	.	.	.	.	.	.	II^{1-2}	.	.	.	.	.
Character taxa of Molinio-Arrhenatheretea																																			
Lysimachia vulgaris	.	I^{+}	.	.	.	.	I^{+}	I^{+}	.	I^{+}	.	.	.	.	I^{r-+}	I^{r-+}	I^{r-1}	I^{r-+}	.	.	I^{+}	.	.	I^{+}	I^{+}	.	.	I^{+}	I^{+}	I^{r}	.	.	.	.	.
Lythrum salicaria	.	.	.	.	.	.	.	.	I^{+}	I^{+}	I^{+}	.	I^{+}	.	I^{+-1}	I^{+}	I^{+}	I^{r}	I^{+}	.	.	I^{+}	.	.	.	.	I^{+}	I^{r}	.	.	.	.	.	.	.
Carex panicea	.	.	.	.	.	.	.	.	.	I^{+-1}	II^{+-1}	.	.	.	I^{+-2}	I^{1}	.	I^{r}	.	.	.	.	.	.	.	.	II^{+-2}	.	.	.	.	.	.	.	.
Carum verticillatum	.	.	.	.	.	.	.	.	I^{+-2}	I^{+}	.	.	.	.	.	I^{+-2}	I^{+-2}	I^{2}	.	.	.	.	.	.	.	.	I^{+-1}	.	.	.	.	.	.	.	.
Other phanerogamic companions																																			
Molinia caerulea	.	I^{+-1}	.	.	.	.	I^{+-1}	II^{+-2}	.	II^{+-2}	III^{+-1}	.	I^{+}	I^{+}	III^{+-3}	I^{+-2}	II^{+-1}	II^{r-3}	I^{+}	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
DEa Mentha aquatica	.	.	.	.	.	.	.	I^{1}	I^{+}	III^{+-2}	.	.	III^{1}	I^{+}	I^{+-2}	II^{+-1}	I^{+-1}	I^{+}	II^{+}	.	.	I^{+}	.	II^{+-1}	I^{1}	.	IV^{r-2}	I^{+}	.	.	.	.	.	.	.
Galium palustre	.	.	.	.	.	.	.	.	I^{+-1}	I^{+-2}	.	.	V^{+-1}	3^{+-1}	I^{+-1}	I^{+-1}	I^{+-2}	I^{1-2}	III^{+-1}	2^{+}	II^{+-1}	.	2^{+}	II^{+}	I^{1}	.	I^{+}	.	3^{+}	.	.	.	.	.	.
Myriophyllum alterniflorum	I^{+}	I^{1}	V^{+-3}	II^{+-1}	I^{1}	I^{2}	.	I^{1}	II^{1-2}	.	I^{4}	.	.	.	.	I^{+}	.	.	.	.	.	.	.	.	I^{+}	V^{+-3}	I^{2}	I^{+}	.	.	I^{1}	3^{4-5}	II^{1-2}	.	.
Drosera intermedia	.	.	.	.	.	.	I^{+}	I^{+-1}	.	I^{+-1}	I^{+-1}	.	I^{+}	.	I^{+-1}	I^{1}	.	I^{1}	.	.	.	.	.	.	.	.	.	I^{+}	.	.	.	.	.	.	.
Myrica gale	.	.	.	.	.	.	.	.	.	I^{+-2}	II^{+}	II^{+-3}	.	.	I^{r-2}	.	.	I^{+}	.	.	.	I^{+}	.	.	.	.	I^{r}	.	.	.	.	.	.	.	.
Lemna minor	.	.	.	.	.	.	.	.	I^{2}	I^{+}	.	.	.	.	.	I^{+}	I^{+}	I^{+}	.	.	.	.	.	I^{1}	II^{3-5}	.	I^{+}	I^{+}	.	.	III^{+-1}	.	.	.	.
Anagallis tenella	.	I^{1-2}	.	.	.	.	.	I^{1}	.	I^{+-2}	I^{+-1}	.	.	.	.	I^{2}	I^{+}	I^{1}	I^{+}	.	.	.	.	.	.	.	I^{+-1}	.	.	.	.	.	.	.	.
Carex serotina	.	.	.	.	.	.	.	I^{1-2}	.	I^{+-1}	I^{+}	.	IV^{+-1}	2^{+-1}	III^{r-4}	II^{+-2}	I^{1-4}	I^{+}	.	.	.	II^{+}	.	I^{2}	I^{+}	.	II^{+}	.	.	.	.	.	.	.	.
Bryophytes and algae																																			
Sphagnum sect. Subsecunda	I^{1}	I^{+-1}	.	.	II^{+-2}	.	V^{+-4}	I^{+-3}	I^{2}	I^{+-1}	IV^{1-5}	I^{1-5}	I^{2}	I^{2}	II^{+-5}	II^{+-5}	II^{+-4}	III^{+-5}	.	.	.	.	.	.	.	.	I^{1}	.	.	.	.	.	.	IV^{1-4}	V^{+-5}
Sphagnum cuspidatum	.	I^{+-1}	.	I^{+}	I^{+}	.	IV^{+-4}	I^{+-1}	I^{+}	I^{4}	.	.	.	I^{1}	I^{+-4}	I^{+-4}	I^{2-5}	IV^{+-5}	.	.	.	.	.	.	.	.	.	II^{+}	I^{1}	.	.	.	.	IV^{1-3}	I^{1-5}
Drepanocladus fluitans	.	.	.	III^{1-5}	I^{+-1}	.	IV^{r-3}	.	.	I^{3}	.	.	.	I^{3}	I^{+-1}	II^{+-3}	I^{+-3}	I^{+-3}	.	.	I^{2}	.	.	.	.	.	I^{2}	.	.	I^{+}	.	.	II^{3-4}	.	II^{+-4}
Scorpidium scorpioides	.	I^{1}	.	.	.	.	.	I^{2}	.	I^{+}	II^{2-5}	.	III^{+-3}	I^{3}	I^{+-3}	.	.	I^{1}	I^{2}	.	.	.	.	.	.	.	I^{1-2}	II^{+}	.	I^{1}	.	.	.	I^{5}	.
Calliergonella cuspidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I^{1}	I^{1}	I^{+}	.	I^{1}	.	I^{1}	I^{+}	I^{1}	I^{1}	I	.	I^{r-3}	I^{+}	.	.	.	.	.	.	.
Chara spec.	.	.	I^{+}	.	I^{+}	.	.	I^{+}	I^{+}	.	.	.	.	.	.	.	I^{1}	I^{5}	I^{+}	.	.	.	.	I^{+}	.	.	II^{+-5}	I^{2}	.	I^{5}	.	.	I^{3}	.	.

= geographic differential

DEa = differential of Eleocharition acicularis

S-L = Samolo-Littorelletum

STELLINGEN

I

Ondanks het hoge niveau van de organisatie van natuurbehoud en natuurbeheer in Nederland is het niet mogelijk, de levensgemeenschappen der matig voedselarme vennen en soortgelijke wateren in dit land in stand te houden

II

Een van de bedoelingen van de nomenclatuurregels in de vegetatiekunde is het ontstaan van homonymen te voorkomen Dit blijkt expliciet uit artikel 17 van deze regels (Moravec 1968) Door artikel 13 uit dezelfde regels wordt dit ontstaan evenwel juist bevorderd

MORAVEC, J 1968 Zu den Problemen der Pflanzensoziologischen Nomenklatur Ber Int Symp Pflanzensoz Syst , Stolzenau/Weser 1964 142 154

III

De term „consortium" dient niet gebruikt te worden in de door van Leeuwen (1958) aangegeven betekenis, omdat hij reeds eerder (Reinke 1894-1896) in een geheel andere zin is gebezigd

VAN LEEUWEN, C G 1958 De kievitsbloem in Nederland De Levende Natuur 61(12) 268-278
RABOTNOV, T A 1972 Consortia, the importance of their study for phytocoenology Folia Geobot Phytotax 74(1) 1 8

IV

Bij de beoordeling van fytocoenologische trouw dient het optreden van polycormen negatief te worden gewaardeerd

JAKUCS, P 1972 Dynamische Verbindung der Walder und Rasen Hong Akad Wetensch Budapest

De gegevens van Wheeler, Baker en Hanchey vormen geen bewijs voor het optreden van pinocytose in cellen van het wortelmutsje

WHEELER, H , B L BAKER & P HANCHEY 1972 Pinocytosis in root cap ceels exposed to uranyl salts Amer J Bot 59(8) 858-868

VI

Het door Weiss gemaakte gebruik van de aanduidingen „herbivoor" en „carnivoor" voor Protozoa die zich voeden met Monera en Protista is inconsequent

WEISS P B 1971 The Science of Biology, 4th edition

VII

Van Gelder (1973) gebruikt ten onrechte het engelse woord „fen" als vertaling van het nederlandse „ven"

VAN GELDER, J J 1973 Ecological observations on Amphibia in The Netherlands II *Triturus helveticus* Razoumowski migration, hibernation and neotony Neth J Zool 23(1) 86 108

VIII

De onkunde en het onbegrip van journalisten inzake natuurbehoud en milieubeheer worden treffend geillustreerd door de regelmatig opduikende berichten over door brand „verwoeste" heidevelden en andere natuurgebieden, terwijl de door zulke branden aangerichte schade van geen betekenis is vergeleken bij de vernietiging van natuurgebieden door cultuurtechnische werken Daarover zwijgt de pers echter in alle talen

Nijmegen, 21 juni 1973 M M Schoof-van Pelt